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BUILD THE ROAD FOR THE TRAFFIC

The title of one of the papers to be presented at one of the October conventions indicates the tendency in some quarters to limit the weight and speed of traffic to the condition of the roads to carry it. The opposite of this tendency is the title to this editorial. Either one, pushed to the limit is bad, but progress demands that the emphasis be put on the improvement of the road to suit the increase in the traffic.

There are practical limitations to the increase in the weight which can be carried on motor trucks, for example, such as strength of bridges and culverts, sufficiency of pavement foundations, steepness of grades and the like, which would require entire rebuilding of whole systems of roads, but these limitations are accompanied by the limitations in the economy of operating the trucks, which must be taken into consideration in planning the wholesale reconstruction suggested.

An example may be taken from the railroad field. Standard methods of construction, fixed widths, heights and strength of bridges and tunnels, location of platforms and buildings and sharpness of curvature. These prevented increase in dimensions of cars and of locomotives with certain increases in the demands of traffic and the first cry was to restrict the traffic to the roads as built. But new roads built according to the new demands demonstrated the economy or lack of economy of the methods used to meet these demands, and when the principles thus developed were applied to the old roads, they were rebuilt or not according to the judgment of the engineers as to the economy of the reconstruction.

The same lessons are being learned with respect to highways. Millions of dollars have been wasted in new highway construction because the increase in traffic was misjudged, and still more because the roads were built for the existing traffic rather than for that which the better road would develop.

It will be necessary to restrict weight and speed of traffic on the old roads, but the slogan for the new roads should be "Build the Road for the Traffic" with a long look into the future. When the economy of this method of building roads has been demonstrated then the question of rebuilding the old roads will be merely one of the local conditions.

In the process of testing out the economy of the new roads built under this slogan, the economy of transportation in large or small units, self-propelled or drawn, will also be tested, and, just as in the railroad case, weights and speeds will find their limits in the units of transportation, when economy of transportation has its full consideration, and the roadbed itself will be a secondary matter in this study of economy.

"Build the Roads for the Traffic" is the watchword which will lead to true economy and result in expansion, not restriction of traffic.

In a continuous performance such as the development of traffic economy wins in the end, tho much money may be wasted in learning what is true economy.

HOW TO BUILD PAVEMENTS

The standardization of pavements has progressed by means of the standard specifications adopted by the American Society of Municipal Improvements, an organization composed of the expert municipal engineers of the country and the officials of many cities, and therefore well qualified to prepare authoritative specifications. This organization recognizes the fact that improvements are made from year to year and retains its expert committees to modify the specifications to include all the changes which are real improvements. But one specification, that for wood block paving, remains under discussion without adoption, and it bids fair to be agreed upon at the Newark convention in October.

There have been many new improvements in the use of nearly all the prominent paving materials, and the list of newly patented pavements is very long.

This seems to be an opportune time to begin a series of articles upon the practical design, construction and maintenance of pavements, bringing the text-books down to date and including mainly the practical construction details which are not found in the ordinary text-books.

The first article of this series, on the design of brick pavements, appears in this number and will be followed by articles on construction and maintenance of brick pavements. It is the purpose to cover in similar fashion the standard forms of street and road surfaces and such of the special forms as are demonstrating their adaptability to the conditions of every day use on streets or roads.

The articles will be of every-day value to engineers, roads and street superintendents and to contractors, for they will be written by or based on data and information furnished by engineers and contractors directly connected with and engaged in the daily work of construction and maintenance.

The business department will try to anticipate the demand by keeping in stock enough copies to supply all requests for subscriptions beginning with this series, but early application is recommended in order to secure every number.

Our readers who have worked out special designs suitable for particular conditions or who have developed special methods or apparatus for construction are invited to contribute them to the series, that it may be as complete as possible. All acceptable contributions will be paid for.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE DESIGN OF BRICK PAVEMENTS

By the Editor

The intent of the series of articles of which this is the first is indicated by its title. The various pavements will be taken up in detail as to design, construction and maintenance, the general treatment of the subject of design being indicated by this article upon the design of brick pavements. It is intended to make the series a practical guide for engineers in design, contractors and engineers in construction and street and highway supervisors and superintendents, contractors and engineers in maintenance.

The various articles will be written by theoretical and practical experts in the three lines, with such collection and editing of material gathered from these authoritative sources as will make the articles coherent and readable and a consistent whole.

It is hoped that the readers of the series will from time to time supply any omissions or deficiencies and discuss any unsettled questions which they may be moved to reply to and especially to contribute such practical descriptions of materials and methods as they may have devised or used, that the completed series may be as full as possible of usable hints and descriptions of methods and results for the benefit of engineers, contractors and street and road supervisors.

The design of the brick pavement has been a development in this country for the 40 years or more since the first pavement was laid, progressively toward the monolithic construction, which is the latest development for this form of paving.

The first brick pavement laid in this country, probably, was a small area laid by a property owner in Charleston, W. Va., in front of his store, where the lack of drainage made an almost continuous mud hole. This piece of pavement seems to have been laid on a foundation of boards, laid practically in the mud, a cushion of sand being used to give the bricks a uniform bearing. Possibly the boards were dipped in tar. The date of this construction was probably 1872. This pavement lasted for nearly 40 years before it was replaced by a modern bitulithic pavement. It was so successful that within a few years a considerable length of street was laid in about the same manner, and this in turn lasted nearly 40 years. It was removed in the spring of 1915 and the boards forming the foundation were, many of them, still in fair condition, perhaps because they were dipped in tar and in part, perhaps, because the poor drainage of the sub-soil kept them almost continuously wet. At any rate, they were far from rotted away when removed.

Bloomington, Ill., long claimed the honor of laying the first brick pavements, and perhaps deserves the honor since larger areas were laid. These pavements attempted to get the uniform bearing necessary to keep the surface reasonably smooth, first with a sand cushion on a slightly compacted sub-grade and then by means of a layer of brick laid flat on a sand bed and with a sand cushion on top of which to lay the wearing surface of bricks on edge.

None of these forms of construction really made a uniform surface, and the irregular settlement of individual bricks on account of disturbances and displacements of the foundation below, caused rapid wear of the surrounding bricks, breakages and exceedingly rough surfaces for most of the life of the pavements.

To reduce these irregular displacements of bricks, the concrete foundation was adopted, retaining the sand cushion, and almost all brick streets for the past 20 to 25 years have been built with such foundations.

The better foundations emphasized some of the other defects in the early brick pavements and started movements toward their improvement. Thus the reduction in the unequal settlement of bricks gave a better opportunity to show that the formation of holes in brick pavement surfaces was due to the unequal wear of bricks of varying hardness. A soft brick in the midst of an area of hard bricks gave way under the stress of traffic, and the hole thus formed was just as ruinous to the good bricks surrounding it as tho the brick had settled.

Some of the earlier pavements were really laid with well-selected, hard-burned, common building brick, but, being well selected, they were uniform in quality and their wear under traffic was therefore fairly uniform. When the first attempts to make vitrified brick hard enough to stand the traffic were made, the product of the kilns was irregular and so the wear in the street was irregular.

Again, the sand used in filling the joints was not a protector of the edges of the brick, nor did it do much to keep the bricks in place. One result of this trouble was the invention of the repressed brick, which attempted, by rounding the edges of the bricks, to prevent the undue wear of those edges resulting with the wire-cut bricks. This introduced other complications, and in an attempt to reduce the number of joints the size of the bricks was increased, each manufacturer having a different idea of what the size should be, largely based on his observation of the action of his own bricks in pavements.

Another line of effort to prevent the wear of the edges of the bricks was the improvement of the filler. Tar and later asphalt were used, and but little later the use of a cement grout filler was tried. This was not very popular for some time, first because the high cost of cement at that time made the cement joint filler expensive, and, second, because the rounded corners of the popular repressed blocks caused the thin edges of the cement filler over them to chip off and the joint to wear faster than the brick. It was considered necessary to have lugs on these repressed blocks to hold them

far enough apart in the laying so that the cement grout could get in and fill the joints, and this aided in retaining the popularity of the repressed block until the wire-cut lug block was invented. Since the latter combines the advantages of the wire-cut brick as to sharp edges of bricks and greater density, with the lugs, which seemed to be the principal advantage of the repressed form, their use has rapidly increased. The cement filler is specially adapted to the joints of the wire-cut lug blocks.

The increase in the solidity of the pavement in other respects ultimately called attention to the occasional displacements of the sand cushion and consequent displacement of the bricks resting on it, which is more pronounced and frequent with sand or soft fillers than with the cement filler, and has led on the one hand to the invention of the monolithic construction of brick pavements.

The more uniform wear of bricks of uniform quality, set solid, leads to the suggestion that the bricks need not be of so great depth, and with the monolithic construction there is a strong tendency to reduce the vertical dimension of bricks to 3½ or even 3 inches, instead of the standard 4 inches.

One development of the asphalt filler for joints has been to spread the asphalt over the wearing surface of the brick also, the wire-cut bricks being laid on a wire-cut, or so-called flat, side so as to give a rough surface for its adhesion to the brick, and providing a thin bituminous wearing surface. This is the so-called vertical fiber brick pavement.

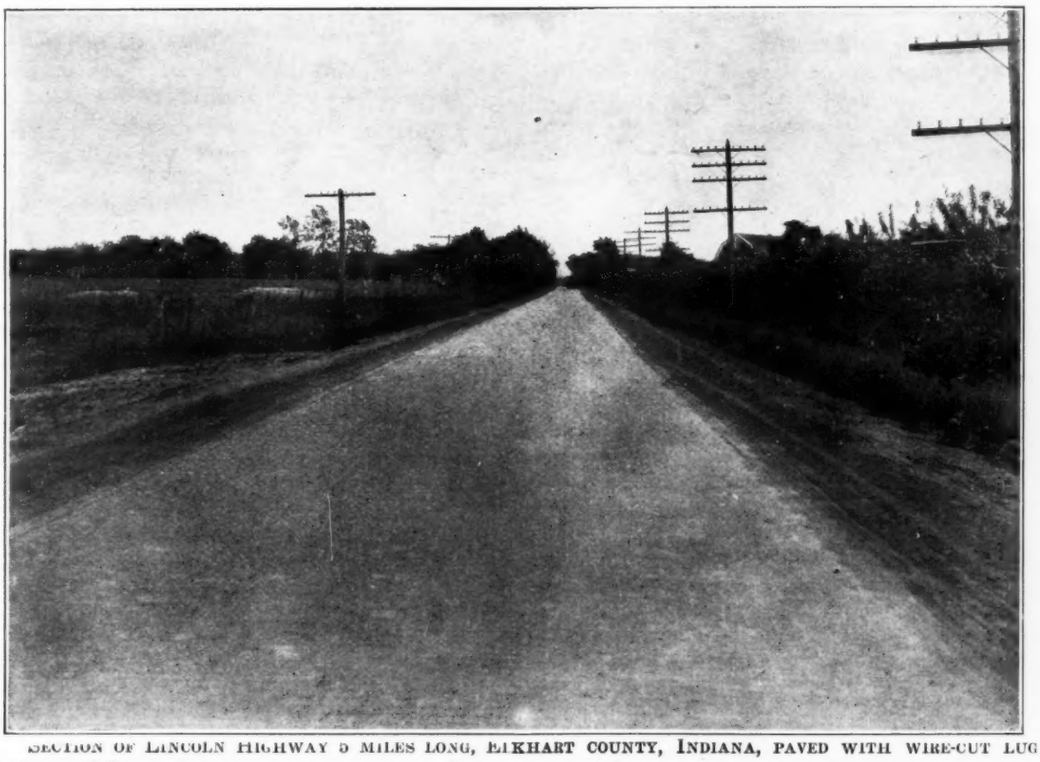
The difficulties in the manufacture of brick as to variations in sizes, irregularities in structure, in hardness, in burning and other technical qualities have been attacked by the brick makers with energy and under the advice of experts in both the chemistry and the mechanics of the processes, and the quality of brick has been greatly improved. The ability of brick makers to meet a definite specification is much greater than in the past, and the standardization of materials, sizes, methods of manufacture, of handling, of shipping and of the finished and delivered product is each year more nearly complete.

This brief statement of the history of the development of the brick pavement will give the reasons for every item in the present standard specifications for brick pavement.

The concrete foundation, or its equivalent in a perfectly drained and thoroly compacted foundation of other material seems to be a necessity for the best results with any block pavement, and for heavy traffic cannot be dispensed with under any circumstances, even solid rock sometimes requiring enough concrete to even up the irregularities in natural surface or produced in excavating to grade.

The thickness of the concrete foundation depends on the one side upon the weight which it must support and distribute over the soil beneath. On the other side it depends on the character of the material beneath it and the thoroness with which it is drained. The effect of water in the soil under a concrete pavement is described below, and each year the economy of so draining the sub-soil that all water shall be removed before it can reach that portion under or affecting the pavement is becoming more apparent.

The systems of drainage proposed are numerous. A popular system has been to run drains down the center of the pavement, with outlets to ditches or catch basins, or other drains at intervals along the line of the road or street, but since the object is to keep the water from reaching the subsoil under the pavement, as well as to remove it, it would seem to be better engineering to lay the drains at or outside the edge of the pavement, where they would serve both purposes, unless, indeed, the sub-soil is so bad that drains must be laid more thickly to carry away the water coming to it from below or from sources that cannot be cut off by the side drains. The depth of the drains must depend upon the nature of the soil; ordinarily they need be laid only so as to be free from frost, and the trenches must then be filled with broken stone or coarse, clean gravel so that water entering the soil from the surface can be intercepted before it gets under the concrete. The size of drains depends upon the amount of water they may be expected to gather. Ordinarily the smallest sizes of drain tile, 4 or 6 inches, are sufficient unless



SECTION OF LINCOLN HIGHWAY 5 MILES LONG, ELKHART COUNTY, INDIANA, PAVED WITH WIRE-CUT LUG BRICK IN 1915; PHOTOGRAPHED A YEAR LATER. BRICK PORTION 16 FEET WIDE BETWEEN 6-INCH CURBS, OR EDGINGS. CEMENT-GROUT FILLER USED.

the distance to an outlet is great, in which case the size must be increased as the water gathers.

Whether the concrete foundation should be re-enforced for the highest, most permanent type of pavement, is a question not yet considered of great importance.

The provision in the standard specifications for brick paving adopted by the American Society of Municipal Improvements that the width and depth of bricks shall not vary more than ⅛ inch and the length not more than ½ inch is evidence of the ability of manufacturers to produce bricks of uniform dimensions, something which was said to be impossible a very few years ago. The standard size of small paving brick is fixed at 2½ inches in width, 4 inches in depth and 8½ inches in length. The more general practice is to use the larger size of block, 3½ inches in width, 4 inches in depth and 8½ inches in length. It is now possible to secure bricks of any standard make, of these dimensions, within the limits of variation given, showing that the manufacturers are now able to predict the size of their finished product and make the molds to produce it. Also the manufacturer can so burn his brick and select them from the kiln as to bring a shipment within the variations permitted. If bricks are so selected and classified as to come within the ⅛-inch limit of variation, bricks of different sizes can be used in different parts of the same pavement. This practice will tend to bring bricks of about the same degree of burning, density and texture together, and aids in securing uniformity in wearing qualities.

One possible advantage in allowing the slight variations in size is the ease of repair with other kinds of brick. This is not an unmixed advantage, however, unless the bricks used in the repair are equal in hardness and toughness to the original brick, so as to restore the uniformity of quality and surface which the original pavement was supposed to have.

The top surface of the concrete foundation is required to be true, uniform and parallel to the surface of the finished pavement. This is the general practice, made necessary for the drainage of the surface of the pavement and the almost universal custom of making the two sides of the street alike with gutters on both sides. When streets have considerable slopes, say 4 per cent. or more, the crown need not be so high and the cross-section will have more nearly a straight line for its upper boundary. Where there is considerable slope across the pavement, as on side-hill streets, it may be possible to put the gutter on one side only and make the slope across the street a straight line. The same is frequently possible on country roads.

The reason for making the cross-section straight rather than curved is found in the almost irresistible expansion of the brick surface under the influence of the sun s heat. If the crown of the street is arched there will be a strong tendency for this expansion to raise the crown of the arch to allow for the lengthening of the arch with the expansion. This results in the rumbling so often observed on account of the vacancy between the brick and the cushion. And it results in cracks and in the spalling of the edges of bricks at the joints, all of which are unsightly and ultimately cause a disintegration and excessive wear along such cracks and joints.

If curbs are not set very solidly they may be pushed out by this expansion, damaging sidewalks, inlets, catch-basins, etc. The longitudinal expansion joints along the curbs have been devised to diminish these evils, and if properly constructed are reasonably efficient.

That expansion joints are not necessary when the brick surface is a plane surface and there are no tendencies for the surface to rise in any portion, and the temperature stresses are absorbed by strains in the pavement materials themselves, is shown by the fact that transverse expansion joints are unnecessary so long as the grade or slope of the street is uniform.

A pavement on South Sixth street in Terre Haute, Ind., was laid some 25 years ago without any expansion joints, and in the blocks between street intersections is still in excellent condition. But at each street intersection there was introduced a crown in the pavement of the intersecting street which interrupted the straight line of the pavement along Sixth street, and at each intersection the force of the expansion of the Sixth street pavement was sufficient to lift the arch of this crown and so the pavements at the intersections were broken up and had to be relaid with due provision for expansion. This same tendency to lift the pavement is found wherever the grade of a street changes, so that the longitudinal profile is convex upward and cracks or even explosions occur at such points. If the profile is concave upward the stress comes on the surface of the brick and joints may be pinched out or crushed and edges of bricks spalled off.

The location and character of expansion joints is one of the problems in brick paving which has not yet been solved satisfactorily. It has led many engineers to use bituminous joint fillers, tar or asphalt, which solves the expansion problem but introduces others already mentioned.

The expansion of the concrete base is only less than that of the brick surface because it is protected from the sun's heat by the brick and cushion above it.

There is another source of cracks in pavements in unequal settlements in the foundation. These do not have so pronounced an effect in city streets as in country roads, because city streets are more thoroly compacted by years of use and the spots of settlement are mainly limited to trenches cut for pipes, areas about manholes, spots softened by leaks of water pipes, and the like, which are small in area or at least in width and can be spanned by the ordinary street concrete base, which will carry all but the heaviest concentrated loads if well constructed. On country roads, however, it is seldom that the well compacted area of the old road fits exactly the concrete foundation of the new brick wearing surface, and settlements over portions of the sub-grade along the edges of the pavement, which are insufficiently compacted, or washed out or loosened by drainage improperly provided for, are not infrequent. These settlements are most probable along the edges of the pavement, and when they occur the surface above, as well as the concrete, is cracked on lines roughly parallel with the road and occurring within the middle half of its width.

Again, when the drainage is not properly taken care of, water may seep into the soil under the edges of the pavement, and, if it remains long enough to freeze, the expansion of the water in freezing will lift the edges of the pavement enough to produce cracks quite similar to those described above. These cracks also appear in country roads rather than in city streets, because the latter are usually better protected by curbs, which cut off the water from outside, at least until it is led below the ordinary frost line, and there are more frequent drains by means of sewer gas and water pipe trenches, inlets and catch-basins.

There is a tendency in modern designing of pavements to make the concrete base level across the bottom, giving a crown to the pavement by thickening the concrete in the center. This strengthens the concrete against the bending actions described as the center of the road is approached. Steel reinforcement is sometimes used where the sub-grade is particularly treacherous and cannot be replaced at reasonable expense.

The standard specification for thickness of concrete is 6 inches. This is apparently the least thickness which is safe under all ordinary circumstances, and a greater thickness increases the cost without a corresponding increase in value.

However, bad sub-soil, the condition of which cannot be wholly relieved, will require thicker concrete and perhaps a stone block foundation under it, with sometimes steel re-

inforcement. Thru a marsh not to be drained at reasonable expense a timber raft foundation may occasionally be desirable, on which to lay the concrete. The design of such a foundation is a special problem depending mainly on the local conditions.

Thinner concrete may be used under very favorable conditions, especially with the monolithic construction described below.

The sand cushion on top of the concrete foundation, on which to lay the brick, has been a subject of study no less interesting than that of the brick itself. The requirements as to the sand have varied from the standard specification of "clean, sharp sand, free from foreign matter, except that it may contain not to exceed 10 per cent. of loam," and graded from ¼ inch to that retained on a No. 50 standard mesh sieve, and including broken stone or slag of the same grading, according to the ideas of engineers regarding the function of the sand cushion.

The sand cushion was first introduced simply to even up the soil used as foundation and was made deep enough to cover all inequalities. Its use was continued when boards, brick laid flat, and concrete were used as foundations, for the same reason. When concrete was adopted as the foundation, enough sand was required so that no brick would rest on a projection of the hard foundation and so be subject to breaking across under a heavy load or blow. Smoothness of the upper surface of the concrete was specified until the thickness of the sand was reduced in some specifications to one inch.

Until recently the sand was simply spread and luted to fit the crown of the street and the bricks were laid on this loose sand, on the theory that it was a soft cushion which would distribute itself so as to carry and distribute the loads coming on the pavement, but it was soon found that the sand would compact very irregularly, especially if slightly damp, and might afterward shift to some extent, so that the brick surface, unless made monolithic by perfect jointing with cement grout, was not thoroly stable. But it has not been customary to compact the sand before placing the brick until quite recently, the standard specification now requiring that the cushion be slightly moistened and rolled over its entire surface with a hand roller not less than 36 inches in diameter, 24 inches wide, weighing not less than 10 pounds per inch of width and having a handle 12 feet in length, the cushion being completed by drawing the template over it to finish it exactly to the required surface.

The latest development is the elimination of the cushion entirely. This was done first by mixing cement with the sand used for the cushion before the concrete base had fully set, laying the brick and grouting them, the water from the base and the grout being assumed to be sufficient to make a mortar cushion, so-called, out of the cement-sand mixture. This has now been improved by using only enough of the sand-cement mixture to insure a closely fitting bed for the brick on top of the freshly laid concrete. In this manner the brick pavement is made monolithic, concrete base and bricks being bound into one mass by the mortar and the grout filler.

Due regard to economy as well as to the probable weight of concentrated loads on such monolithic pavements suggests in the minds of some engineers the reduction in depth of bricks to 3½ inches and in depth of foundation to 5 inches, so that a pavement which under the standard design would be 11½ or 12 inches in depth becomes 8½ inches, with a saving in cost of brick and of concrete and the elimination of the cost of cushion, as well as a reduction in the cost of excavation for the pavement. The wear of this pavement should be uniform, the protection of joints complete, and the base to distribute the weight of traffic over the earth foundation is 8½ inches instead of 6.

With these general principles of design as guides it should

CURVE ON GOSHEN-FT. WAYNE SECTION OF LINCOLN HIGHWAY, IN ELKHART COUNTY, INDIANA, PAVED WITH WIRE-CUT LUG BRICK ON AN OLD GRAVEL ROAD FOUNDATION IN 1915. PHOTOGRAPHED A YEAR LATER. CEMENT-GROUT FILLER USED. SUPER-ELEVATION OF OUTSIDE OF CURVE, 10 INCHES.

be possible to solve any special problem when all the data are secured. It is a problem of several variables, character of soil, drainage, weight and amount of traffic, material available for base of pavement, machinery available for construction purposes, quality of brick, and in each item cost of materials and putting in place, and money available. The variations in these items must be studied and combined in various ways until the most satisfactory pavement obtainable for the money available is discovered. The engineer cannot always build the best pavement possible, but must be satisfied with what can be built with the money available. The best engineer is he who secures the best results with the least expenditure. Somtimes he must be satisfied with a poorer pavement so as to cover the ground. Sometimes it is best to build only a part of the pavement, and build that in the highest style of the art, trusting to it to demonstrate the economy of raising money enough to finish the job.

One of the principal factors in the development of the modern brick pavement has been the National Association of Paving Brick Manufacturers, of which W. P. Blair was the organizer and has been the only secretary. Its work was begun 25 or 30 years ago under a committee of the National Brick Manufacturers' Association, which became large enough some 10 or 12 years ago to warrant an independent organization. Another very important factor in the last five years or so has been the engineering organization of the Dunn Wire-Cut Lug Brick Company, which has been very active in developing improvements in methods of constructing pavements as well as the bricks themselves. An active factor in the Southwest has been the Western Paving Brick Manufacturers' Association, which has done much in its peculiar lines toward the encouragement of brick paving in that territory.

MUNICIPAL BATHING FACILITIES

By Frank Koester, City Planner and Consulting Engineer, New York.
Author of "Modern City Planning and Maintenance."

While many municipalities have provided public baths, they seldom have been provided in sufficient number with proper equipment.

Such baths should be on a large scale and be what may be termed aquatic gymnasiums. There should be a large swimming pool some 100 feet or more in length and 40 to 50 feet wide, varying from 3 to 15 feet in depth at different parts, with spring boards for diving and artificial waves.

Steam rooms, sweating rooms and shower baths should be provided, with both hot and cold water. The showers should be arranged to jet either from above, from the wall at the side or from the floor upwards.

The gymnasium should include the various forms of gymnastic apparatus, and it is desirable also to have a running track, which may be constructed as a gallery arranged around the building walls.

A heating plant must be provided for keeping the water heated to the proper temperature, and also for keeping the rooms at a uniform temperature. Arrangements should be such that the pool may be drained and refilled in a short time. Such baths should be in charge of a skilled swimming master, for the instruction of those who wish to learn to swim. Attendants should be at hand to massage those who desire such service.

It is advisable to supply the baths with as many features as possible, in order that they may be utilized to the fullest extent. The price of admission should be low, just sufficient to cover the cost of operation, provided it is not free, while fees for special service, as swimming lessons and massage should be turned into the general fund.

Separate municipal baths should be provided for women, but if this is not feasible, certain days of the week should be set apart for their exclusive use.

The city of New York maintains and operates twelve free public interior baths and eleven free floating baths.

For the use of these institutions, there is no charge whatever, the only requisite being respectable and orderly conduct on the part of the patrons, compliance with the rules, and that the bathers furnish their own towels and soap. This has been the policy almost from the opening of the first public bath, although at the opening of one of the municipal baths the city did undertake to furnish towels and soap at a nominal charge to the bathers. However, it was soon found that the loss of towels was very great; the shower rooms were plastered with waste soap, the floors slippery and the drains choked. Besides a certain percentage of danger from contagion existed unless the towels were laundered under surveilance. All these evils were at once remedied by patrons furnishing their own requisites and the scheme of supplying towels and soap was discontinued.

The United States Volunteer Life Saving and the Women's National Life Saving League have swimming instructors at the pool during certain hours to teach swimming. These hours vary from time to time. Aside from these instructions, an attendant who is a competent swimmer is required to be on duty constantly at the pool, with instructions to pay attention to all swimmers.

During the year 1911, there were 5,400,567 free baths given by the city of New York in both floating and permanent baths. The average cost per bather during that year was a little over 4 cents. During the summer months of 1911, the attendance at the Rivington Street Bath often reached as high as 3,000 in one day.

During the month of December, 1911, each bather used on an average 9.9 cubic feet of water and required the consumption of 8.8 pounds of coal.

The floating baths are all built about on the same plan, as follows: They are 95 feet long and 60 feet wide, and are floated on eight pontoons, placed four on each side of the bath. In the center there is a large well, divided into two parts, one 93 feet long and 34 feet wide, for adults and one 70 feet long and 8 feet wide for children. The depth of the water in the large well is 4½ feet and in the small one 2½ feet. There are 68 dressing rooms opening upon a small gangway around the edge of the well.

The floating baths, like the interior baths, are free, but the former are used only during the summer.

IRON AND STEEL SEWER PIPE

By J. F. Springer, New York.

While the use of cast iron and steel for sewer pipes is not general, there are some places in which their use is necessary and this article on the methods of laying and testing pipe and protecting will be of value to many engineers and contractors. The special machinery and apparatus described will be of particular interest.

IRON and steel pipe are used for sewer construction in diameters from 4 to 60 inches or more. While these materials are not often used, they are very important when used, and their design should be made on proper principles.

The thickness of the pipe depends upon the allowance for deterioration. Approved practice considers ¼ inch the proper amount for water pipe, but sewer pipe, laid in locations where there is unusual exposure to corrosive influences, may require a greater allowance. It also depends upon the internal pressure, which is affected by the hydrostatic head, the internal radius of the pipe, the tensile strength of the iron and also by water hammer. The same formulas are used for determining thickness as for water pipe. But practically the pipe is chosen as standard, light or heavy, according to the stresses expected and the catalogs of the pipe makers. Again thickness may depend upon the pressure from without, especially if steel pipe is used, and buried deep in the soil, as later described.

Some practical points in handling pipe follow:

It is often necessary to provide special appliances for handling cast-iron pipe during construction operations, even a 4-inch pipe weighing about 200 pounds per 12-foot length, while a 36-inch pipe will weigh 3,800 pounds. A very convenient device is the sulky derrick. This is scarcely a derrick at all. It consists of an A-frame, to which is hinged a simple leg. The hinge is attached at the top of the A. This arrangement straddles the trench and provides a suitable support for a block and tackle. The drum or windlass which operates the block and tackle is mounted in the A-frame in such position that the two twin wheels controlling the drum clear the vertical ropes, carrying the weight of the pipe length. When it is desired to shift the derrick it may readily be moved by making use of the wheels. A simple brake may be arranged to control one or both wheels, and so the lowering of the pipe.

If cast-iron pipe is to be laid on a curve, special castings will be advisable, even when the curvature is very gentle—say, 1 degree from length to length. This would mean a radius of curvature in excess of 500 feet. This degree of deviation may at times be obtained by withdrawing the spigot about ¾ inch.

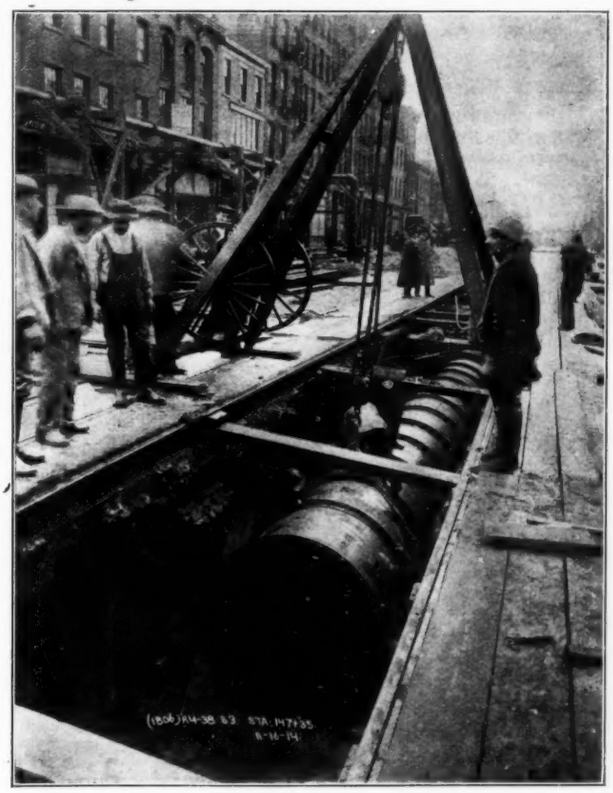
Cast-iron pipe lengths have been successfully bent, as in a line which conveys water of the Guayabo River to the town of Preston in Cuba. Thru some oversight the piping for the line was shipped without any curves or sleeves. The route was quite crooked and the delay to wait for the specials would be serious. Steel and wrought iron pipes had previously been bent in connection with work, so a local engineer determined to test the possibilities of cast iron. The pipe had a diameter of 10 inches, a wall thickness of 9/16 inch, and weighed about 760 pounds per length of 12 feet. Old rails with the proper curvature were set up to form a cradle in which the pipe lengths might comfortably lie after they were bent. Half a dozen or more lengths were placed side by side on the cradle, the lengths forming chords in the arcs made by the rails. A fire was built of hardwood in such a way as to heat the pipe-length, but to leave the extremities outside of its active influence. The purpose served by not heating the ends was the prevention of the collapse of the piping. In the course of 1½ to 2 hours the metal would be sufficiently softened to permit the lengths to settle into the cradle of their own weight. About 40 lengths were bent in this manner. The curvature varied, the minimum radius being 50 feet.

Large cast-iron piping is sometimes laid on block supports. These are placed two to a length and near the ends. There is disadvantage in using blocks because they tend to nullify the distribution of the load and to concentrate it upon themselves. On the other hand, the use of blocks means that the points of support are known locations.

Smaller sizes of pipe, say from 8 inches down, may be lowered into the trench by two men with rope slings, one at either end.

A locomotive crane may be used on sewer work. It is unnecessary to provide a track as the broad-wheel type may be employed. Whether this apparatus is economical in a given case depends upon the conditions. If the locomotive crane is used for excavation as well there will naturally be an increased opportunity to secure advantage.

Cast-iron pipes are ordinarily joined by means of hot lead. Jute packing is driven into the joint as a preliminary. The space is closed in with a jacket of wet clay and yarn or an asbestos jointer. The lead is then poured, and should be poured continuously until the joint is full. No dross should



A FIVE-FOOT RIVETED STEEL SEWER FOR TEMPORARY USE IN CONNECTION WITH NEW YORK SUBWAY WORK. AN A-FRAME DERRICK, AS DESCRIBED IN THE ARTICLE, HANDLES THESE PIPES.

INVERTED SEWER SIPHONS OF CAST-IRON USED IN CARRYING SEWERS UNDER THE SUBWAY IN NEW YORK SUBWAY CONSTRUCTION. THE TWO LARGE PIPES ARE FIVE-FOOT STORM SEWERS. THE SMALLER PIPE IS A 24-INCH SEWER TO CARRY THE DRY-WEATHER FLOW OF SEWAGE. NOTE THE SPECIALS AT THE BEND AT THE LOWEST POINT IN THE SIPHON.

be allowed to collect in the pot. The calking may be done with a hammer and special tools.

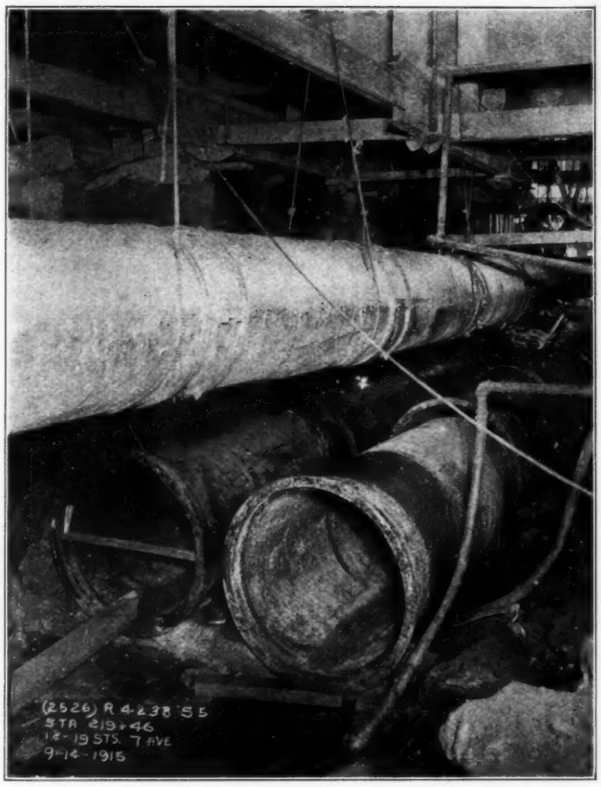
Lead wool has been used. This is a fibrous material which consolidates under the blows of the pneumatic hammer. This is a cold operation all through. An authority mentions still another method as possibly useful where the trench is wet. "A soft lead pipe wrapped around the pipe and calked into the joint at the same time" is the suggestion. If the cast-iron pipe is quite large, the inside of the joint should also be calked.

Steel pipe is also used in sewer construction. It has thin walls, because of the high tensile strength of rolled steel, which give but a slight margin for deterioration of the metal. The coating put on the pipe to protect it must be very carefully preserved up to the time the pipe goes out of sight under the back-filling operation. Persons with hob-nails in their shoes should not be permitted to walk on the pipe or within it. Indeed, in one case, on the Little River Works of Springfield, Mass., a covering of canvas or equivalent material at least 30 inches wide was kept on top of the pipe in the trench until back-filling was in progress on the spot, and no person was permitted on the pipe without rubber or felt soles on his shoes.

Sheet steel pipe of considerable size will ordinarily need more or less bracing within, especially during the back-filling. The lower part of the back-filling should be well tamped. It is recommended that in putting in the upper part of the back-filling a commencement be made at the middle of the length of pipe. This procedure leaves the field joints to the last, and so prolongs opportunity for the hydrostatic testing of the joints in advance of covering them up. Naturally, a sheet steel pipe will sag somewhat under back-filling. The braces will hardly prevent this entirely. However, after the removal of the braces subsequently to the back-filling, the sag should be moderate in amount. If the major and minor axes differ no more than 5 per cent. from each other, this difference may be viewed as permissible.

Jersey City has a big sheet steel sewer. The diameter is 6 feet and the standard length 18 feet. These sections weighed very much less than would cast-iron pipe of the same diameter and length. Nevertheless, the individual lengths weighed 6 tons. The laying of sheet steel pipe is facilitated by the possibilities of handling it in long lengths. This reduces the number of field joints and so reduces the total liability to leakage. A steel sewer pipe was laid in St. Louis some years ago for the water works in which the lengths were 28 feet each.

Where cast-iron pipe of considerable size has to be installed in deep vertical sections it may be advisable to have the surfaces of contact machined to true planes. Otherwise, the lower courses will be supporting great weights on uneven surfaces. The cast-iron mains used in the Astoria-Bronx Gas Tunnel beneath the East River at New York pass down and



TWO CAST-IRON STORM SEWERS BELOW, EACH FIVE FEET IN DIAMETER. TEMPORARY STEEL PIPE FLUME ABOVE TO CARRY SEWAGE DURING CONSTRUCTION OF THE INVERTED SIPHONS UNDER CONSTRUCTION BELOW.

up vertical shafts perhaps 225 feet in depth. This pipe is very large, being 6 feet in diameter. The contact surfaces are machined. This pipe stands, however, without the support of a back-filling.

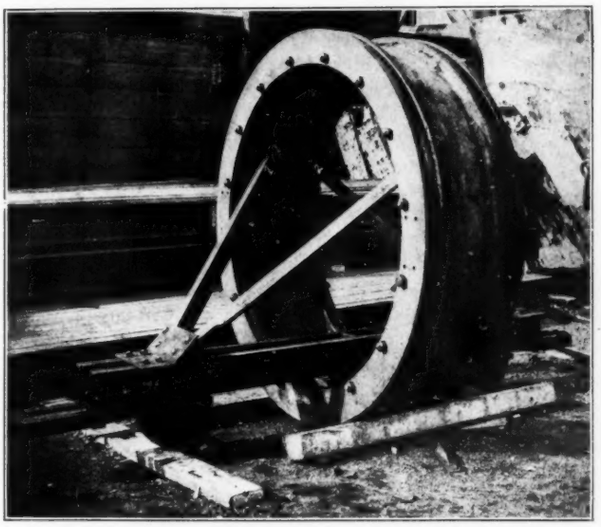
We may learn lessons valuable in connection with metallic sewers by paying attention to experiences gained in laying cast-iron and steel pipe for other services, particularly pipe laid as water and gas mains.

In the laying of sewers it is sometimes necessary to cross a stream or other body of water with the pipe line, a problem the same as if the pipe were part of a water supply system. Reference may be made to the cast-iron siphon across the Narrows at New York, this siphon being part of the new Catskill Aqueduct. A movable skidway, one end of which was held above the surface by a barge, was used in laying the pipe. The joints were made on the barge and above the water level. As length was added to length the barge would shift and thus permit 12 feet more of pipe to slide off the bottom of the skidway which reached down to about the lowest level of the trench. As new lengths took their place in the trench the joint had to undergo flexure. The method of meeting this problem was described by the present writer in MUNICIPAL ENGINEERING for September, 1915, vol. xlix, p. 92.

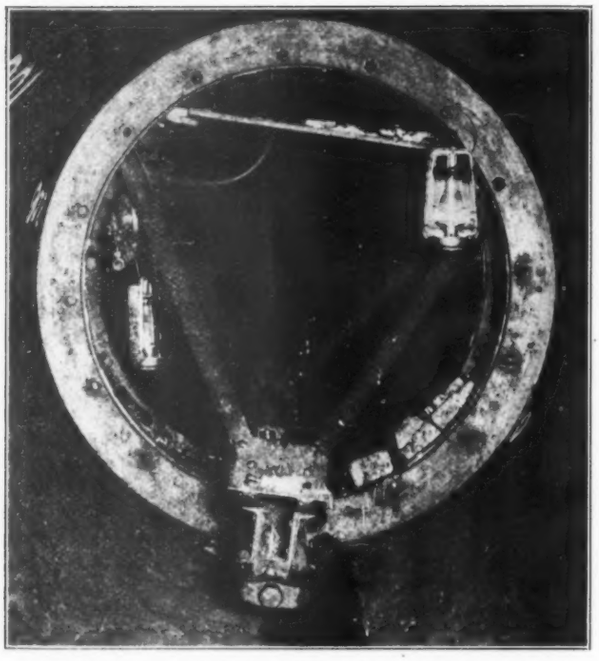
At Boston a similar problem had to be solved in laying two pipe lines beneath the water separating Deer Island from the city proper. One line had a diameter of 8 inches, the other of 12. In both cases ball and socket joints were employed. That is to say, lead poured into the joint clung to either the spigot or the bell, the spherical surface of contact being supplied by this lead and the bell or spigot, respectively. The iron surface to which the lead was to cling immovably was provided with suitable irregularities. In the case of 8-inch pipe the spigot was provided with circumferential ridges and the bell was given a concave spherical surface. An objection to the form of joint used was that a flexure of the joint would expose the lead, which by a reverse flexure would be liable to be skived off. The 12-inch pipe was laid later and seems to have avoided this objection. The bell was provided with two circumferential grooves and a ridge. The spigot was given a convex spherical surface. The ridge within the bell was set well within its mouth, and, in fact, formed the interior limit of the lead. This ridge contacted with the curved surface of the spigot in a circumferential band 0.6 inch wide. "The lead is held within the bell and does not emerge when the pipe shifts position." The pipe was assembled and the joints were made on shore. A large runway was provided and the pipe was set on rollers in it. The water to be crossed was 500 feet in width. A capstan set up on the shore opposite to the pipe in the runway provided a means of hauling the pipe across. This 12-inch pipe had a wall thickness of 1 inch. Later on some 4,000 feet of 4-inch pipe was laid in the water separating Long and Spectacle Islands. This pipe was very heavy, weighing about 350 pounds per length of 12 feet. The water in which it was laid had a maximum depth of about 28 feet. Here the skidway-and-barge method was followed. The skidway was quite long for the moderate depth —115 feet being the length.

Sheet steel pipe may be given a lining of Portland cement mortar. This was done in connection with the construction of the steel siphons to the north of New York City in the line of the Catskill Aqueduct. In a typical case the lining was made two inches thick, of 1:2 mortar. Another similar example was the wrought-iron pipe laid at Charlestown, near Boston, many years ago. The cement lining was 1¼ inches thick. On the outside was a coat 2 inches in thickness, the intervening iron having had, originally, a thickness of 0.16 inch. After about 30 years some of this 30-inch wrought iron, cement-covered pipe was taken up in order to relay with cast-iron pipe. "The reason for relaying was in no way caused by a failure of the old pipe, part of which is still in use, and which, when laid in unyielding soil, has given good satisfaction."

Steel pipe unprotected by cement or cement mortar is liable to undergo perforation from the corrosive activity known as pitting. The obvious remedy, if the use of Portland cement is not possible, is to use a thickness of metal in excess of that necessary by considerations of pressure. An authority—Mr.



THE TESTING BULKHEAD FOR APPLYING THE PNEUMATIC TEST TO JOINTS IN CAST-IRON PIPE LINES, AS DESCRIBED IN THE ACCOMPANYING ARTICLE. PIPES ARE SEVENTY-TWO INCHES IN DIAMETER.



THE TESTING BULKHEAD FOR APPLYING THE PNEUMATIC TEST IN PLACE, READY FOR MAKING THE TEST.

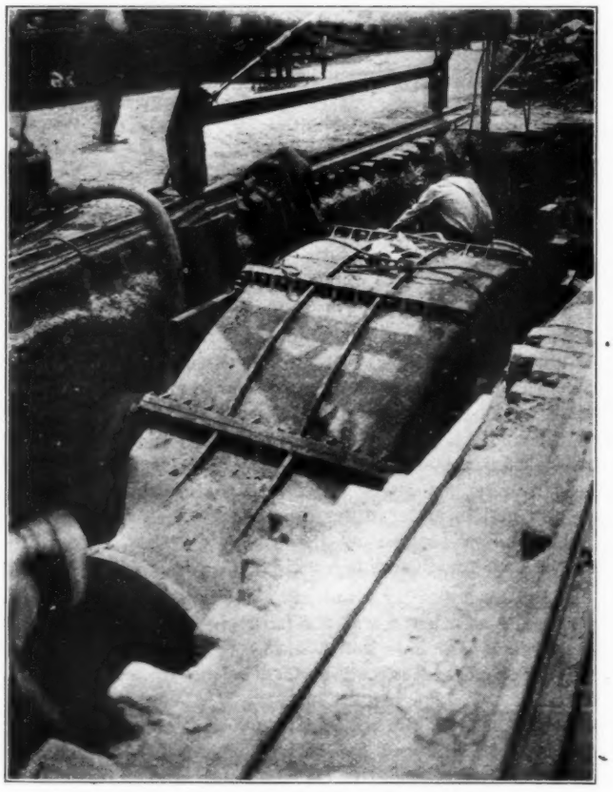
Allen Hazen—says in this connection: "It is my feeling that it will not generally pay to increase the thickness of steel plates very greatly because of this consideration (viz., that thickening the plates will not cure the trouble but will merely prolong the life of the metal), but that the money will be better spent in better coating and in more careful inspection of the steel plates, or, in other words, by preventing the pitting instead of trying to make the plate thick enough so that the pitting will not go thru it." Steel pipe lines are more or less subject to deterioration, due to electrolysis, caused by electric currents escaping from trolley lines, etc. The same authority advocates special protective measures rather than an increase in the wall thickness of the pipe. Such protective measures are the use of insulation joints and the provision of an insulating envelope around the pipe in the neighborhood of the trolley lines, etc.

The backfill is the focus of one of the problems connected with the use of sheet steel pipes. For ordinary depths the minimum thickness may be taken as follows: Pipe 36 inches in diameter should have a thickness of at least 3/16 inch; 48 inches, 1/4; 60 inches, 5/8; 72 inches, 7/8. If the trench is deep and the backfill accordingly weighty, the thickness should be increased. Naturally, if the thickness is sufficient for the backfill, but inadequate to the internal pressure, it will have to be made greater. It seems that proper tamping has a great deal to do with the ability of the steel pipe to resist the backfill. A competent engineer related: "I had the pipe (a drain) put in and it failed; and I had it put in again and great attention paid to the ramming of the earth below and at the sides of the pipe, and it then stood the pressure of the fill."

Attention has already been given to flexible joints used in laying heavy metal sewers under water. At Seattle, Wash., some 48-inch cast-iron pipe was laid in tidal water for perhaps 1,100 feet out from the shore line. The sewer runs out perpendicularly to the shore to a point in Puget Sound, where the discharge is 40 feet below high water. The sewer was laid in a trench 4 feet deep. The excavation was very difficult because of the hard material and its sub-aqueous location The first excavation operation consisted in the removal of mud and loose rocks. A dipper dredge performed this service. A diver would go down beneath the water, where he would drill the hardpan or rock and blast some of it loose. A suction dredge assisted in removing the spoil. The pipe was laid, one length at a time. A double pontoon would support between its two floats a 12-foot length of pipe and lower it to position, the pontoon being anchored all the while. A diver down in the trench or nearby would attend to placing bags of concrete beneath and against the pipe length. This work had to be carefully done, as upon it depended alinement and grade. The joints were made by calking lead wool into the crevice. The pipe after being laid and jointed was covered over with concrete in bags. The concrete used for this purpose was made according to the formula 1:3:5—that is, it was not made impermeable.

Another method of placing metal piping under water proceeds by floating a line of connected-up lengths to a position over the final site. This method is readily applicable to sheet steel tubing, but somewhat less so, perhaps, to cast-iron pipe. A steel pipe has a gross volume a good deal in excess of the volume of water having the same weight. Accordingly, by putting in temporary bulkheads at either end, we have an unsinkable boat or pontoon. With cast-iron pipe the wall thickness is necessarily great and this means a heavy weight. The big cast-iron mains in the Astoria-Bronx Gas Tunnel are heavy enough to remain in position in the event of the tunnel being flooded at any time. A length of 12-inch cast-iron pipe weighs about 810 pounds; but the water it displaces weighs only about 700. Consequently, if it were closed at the ends and thrown into the water, it would sink. But there is no such problem with steel pipe.

At Rochester, N. Y., a big steel discharge pipe for the sewage disposal works was laid by the flotation method in the waters of Lake Ontario. The pipe is 66 inches in diameter and the wall thickness ½ inch. On shore the 30-foot lengths were riveted into sections of 120 or 150 feet in length. These



A CAST-IRON SEWER CONNECTION OF LARGE SIZE.

were bulkheaded and then launched, after which they were towed to position over the site. Here a section would be supported by cables secured to two groups of piles which had been placed one at either end of the location. The bulkhead valves were now opened when the pipe section would begin to sink. The cable supports would be slackened so as to maintain control over the sinking. A diver below would take care of the details in connection with the settlement to final position. The joint into the preceding section was of a special character, easy to make under water. That is to say, bell and spigot forms were given to the two pipe ends by riveting on suitable pieces. In addition, an angle bar was riveted into the piece forming the bell in such a way as to provide a fixed flange. Another angle-bar ring was arranged back of the spigot end, where it formed a loose flange. A ring of lead pipe would be set in between this movable flange and the spigot re-einforcement. A series of holes in one flange corresponded to a series in other. The joint was made by passing bolts thru corresponding holes and drawing them up tight. The effect of tightening these bolts was to squeeze the lead pipe and thus produce a seal.

Cast-iron and steel piping are frequently tested hydraulically after installation to determine the tightness of the joints. Generally, if not always, this is done by putting an entire section of the line under pressure. An innovation in a similar connection has been introduced recently which is adaptable to testing the joints of iron and steel sewers. The gas mains in the Astoria-Bronx Tunnel, already mentioned, were required to have joints capable of withstanding a pneumatic pressure of 20 pounds per square inch. A special device was employed by means of which the joints were not only individually put under pressure, but also only the two ends of the pipe lengths were actually involved, and these merely for a radial distance of a few inches. That is to say, a "bulkhead" in the form of a short cylindrical ring with an exterior circumferential groove or channel was placed so as to provide with the aid of the pipe ends an annular compartment into which air might be pumped until the desired pressure was reached. In order to provide end walls that could be expanded and contracted and so provide for a tight seal and later on for a shifting to the next joint, rubber tubes of fine automobile inner tubing were suitably mounted. Air under pressure when admitted to these tubes produced the desired expansion and when allowed to escape provided for collapse. After the bulkhead was in place and the seal properly made by blowing up the two tubes the device was ready for use in testing the joint. Pressure air was admitted to the space bounded by the cylindrical wall of the "bulkhead," the two tubes and the pipe walls on either side of the joint. There seems no good reason why water under pressure sould not be employed in this space. The pressures would ordinarily be higher than the pneumatic pressure required here, but the air pressure in the tubes could be increased to provide sufficient resistance at the regions of the seal.

The Public Service Commission of the First District, New York, has the oversight of much construction. Some of the sewer work falls under its control. Several of the photographs here shown are illustrative of such work.

Meter Boxes Given Away

The Terre Haute (Ind.) Waterworks Company, in twenty minutes, recently distributed more than 600 meter boxes to be used by the citizens of that city as flower receptacles for growing plants.

Mr. Dow R. Gwinn, president and manager, furnishes the following explanation of this free will offering:

"We set 3,000 meters in the early part of the season. These meters come packed five in a box; the length of the boxes is about 33 inches and they are about the right size for flower boxes.

"Instead of burning up the boxes we removed the lids carefully and saved them until a certain date in May. Coupons were printed in the papers which, on presentation at the proper time, would entitle the holder to one of the boxes which could be used for flower boxes on porches or in windows. The time set for giving the boxes away was 9 o'clock. At that hour the street in front of our office was practically blockaded by crowds of people and vehicles of various kinds. At 9:20 the boxes had all been given away. Several photographers were present to take pictures for their respective papers and these were reproduced."

Denver City Government

The power of persistence and a forceful character are shown in the rejection of the commission form of government by the city of Denver, Col., after some years of trial, and the adoption of a form similar to that which has been in operation in Indianapolis for nearly twenty-five years and in other cities for a shorter time. The mayor is supreme in all executive and administrative matters, making all appointments and dismissals, and the council is supreme over appropriations. Unlike Indianapolis, Denver has an auditor, who is independent of both.

Denver retains the initiative, referendum, recall and preferential ballot, so that it has some checks which Indianapolis does not possess.

In changing its form of government Denver has returned to a mayor of the old days when partisan politics was supreme in its city government, and both friends and opponents of Mayor Speer are watching his course as an independent operator of a benevolent despotism, as the form of government is designated by Ellis Meredith.

One difficulty with the many-headed commission was the stoppage of public improvements thru lack of ability of the commissioners to agree upon the improvements to be made. There will be no such difficulty hereafter, as these questions are now in the hands of the Mayor. If he goes too fast he will be turned out by the voters at the next election, if one may judge from the experience in Indianapolis, and if he goes too slow he will do so against very strong pressure from many sides.

GRANITE PAVEMENT CONSTRUCTION

IN BROOKLYN, N. Y.

NEW MACHINERY AND METHODS

This article describes two new and labor-saving machines and their use in street paving. The excavator has demonstrated its efficiency and economy and its ability to speed up the work of the contractor. The new filler mixer shows on this job its economy of labor, and when the experience gained on this job has been used in improving the details it will become a very efficient and rapid worker in its peculiar line.

BROADWAY, in Brooklyn, N. Y., from Havemeyer street to Myrtle avenue, has exceedingly heavy traffic, has a double street railway track and the elevated railway.

The records of the highway bureau of Brooklyn show that Broadway was paved in 1905, from Havemeyer street to Patchen avenue, with asphalt block, costing $2.12 a square yard, including foundation, or a total of $72,809.28. This pavement lasted less than two years, tho under a five-year maintenance bond, and the contractor was permitted under his guarantee to replace the wearing surface with sheet asphalt, late in 1906, without additional cost to the city. Later the contractor abandoned his contract, and the city then repaired the street each year until 1912, at a total cost for the period of $6,868. The surface was then again relaid with wood block in 1912, with a mortar cushion, at a cost of $2.07 a square yard, or $71,092. The contractor for this work also abandoned his contract, and the city has paid repairs estimated at $22,000 on this pavement. The total cost of the pavement for 1905 to 1916 was therefore about $172,800. Two of the accompanying photographs show the condition of the street prior to the new improvement. This statement is made to show the very severe conditions to which the pavement is subjected, and it may be added that it is reported that the original foundation was very poor.

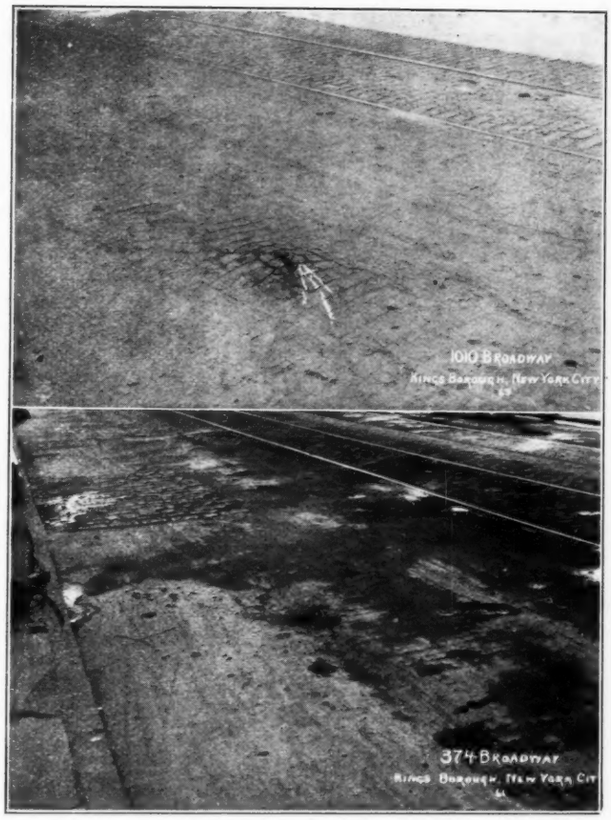
KEYSTONE STEAM SHOVEL EXCAVATING OLD WEARING SURFACE AND DUMPING INTO WAGON. NOTE CLOSE QUARTERS IN WHICH MACHINE WORKS AND ITS ADAPTABILITY TO THE PECULIAR CONDITIONS.

The granite blocks seen between the tracks in the photographs were laid twelve years ago, when the asphalt block pavement was first laid.

In October, 1915, a contract was let for the improvement of Broadway, from Havemeyer street to Myrtle avenue, to Chas. A. Myers Contracting Co., of Brooklyn, with modern granite block pavement, under the latest specifications for the improved type. The total area of the pavement is 34,464 square yards, and the total cost, including a new concrete foundation, is about $126,000.

The specifications provide for a 6-inch concrete foundation, a 1-inch sand cushion, and the latest improved blocks 3¾ to 4¼ inches wide, 4¾ to 5¼ inches deep, 8 to 12 inches long,

KOEHRING PAVING MIXER LAYING CONCRETE FOUNDATION. THIS MACHINE DEVELOPED A CAPACITY MORE THAN 35 PER CENT. GREATER THAN ITS RATING. NOTE OLD GRANITE BLOCK PAVING IN STREET RAILWAY TRACKS NOT REMOVED IN MAKING THE IMPROVEMENT.



VIEWS SHOWING CONDITION OF BROADWAY, BROOKLYN, NEW YORK, BEFORE THE PRESENT IMPROVEMENT. WOODEN BLOCK PAVEMENT UNDER UNUSUALLY UNFAVORABLE CONDITIONS. NOTE THE PATCHES WITH OLD STONE BLOCKS.

cut with smooth heads to lay with ⅜-inch joints. No pea stone are used in the joints which are filled with a tar and sand mixture.

Mr. Myers is using the latest machinery in the work and has made some records as to speed and quality of work with them. One of these machines is a steam shovel, designed and built by the Keystone Driller Co., which is specially fitted for the work of tearing up the pavement, and afterwards the concrete and loading the fragments into wagons standing alongside. The presence of the elevated road structure over the street was allowed for in the plan for work, so that there was a minimum of interference with the work of the machine on this account. The thousands of loaded trucks and the hundreds of street cars pasing during the day demanded the maximum of speed with construction, that the obstructions to traffic might be removed at the earliest possible moment.

It will be seen from the photograph that the ½-yard bucket is mounted and slides back and forth on the I-beams forming the boom of the machine. The boom is lowered and its end dropped until it is parallel with the surface and the bucket then dragged forward and digs its teeth into the layer to be moved until it is full. The boom is then raised and turned until the bucket is over a wagon, when the catch holding its flap bottom is pulled by the engineer and the bucket-load is dropped. Two men only are required to operate the machine. In addition there are a foreman and two laborers who bring up teams and level up for planks laid for the machine to move itself forward on.

The removal of the wood block layer is comparatively easy. Then the concrete layer is attacked; most of it is thoroly broken up by the bucket teeth, but large slabs are sometimes picked up, having areas of 4 to 8 square feet.

The pavement was constructed first on one side of the street railway tracks and then on the other. The wagons stood on the railway track for loading, and there were delays for driving out of the way of cars, but the shovel tore up and loaded the wood block pavement, 11 feet wide, advancing 600 feet a day; and removed the 5-inch concrete at 400 to 600 feet a day. Laborers followed the removal of the concrete and took off 3 inches of the soil below to make room for the new 6-inch foundation and the size of the granite blocks, which is larger than that of the asphalt blocks of the pavement for which the old 5-inch concrete foundation was laid.

This subgrade was thoroly compacted with a 10-ton steam roller.

The roller is followed immediately by a Koehring paving mixer with a rated capacity of 100 square yards a day. It has been laying on the job 137 square yards of the 1:3:6 concrete, using the extension boom which can be seen in the photograph.

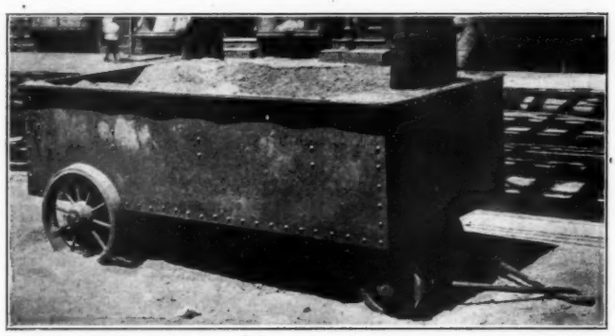
ASPHALT HEATER IN REAR, AND FILLER MIXER, IN FRONT. HOT SAND DUMPED FROM WHEELBARROW ON THE LEFT. POURING JOINTS ON THE RIGHT. NOTE ACCURACY WITH WHICH POURING IS DONE.

One inch of sand is spread on this concrete after it has set and the granite blocks are set and poured as shown in one of the photographs, with a mixture of one part tar and one part fine screened sand.

One of the special pieces of apparatus used on this job was the machine for mixing asphalt and sand for the filler, devised by Fred Hesse, one of Brooklyn's granite paving contractors.

The machine and the tank for heating asphalt will be seen in one of the photographs, and the tank for drying and heating sand in the small photograph accompanying.

The tank of the mixing machine has an axle with 3-inch blades on it spaced seven inches apart, which is rotated by the man holding the handle. The materials are supplied thru the top in proportions of one of tar to one of sand, both heated to 250 to 325 degrees, and when mixed the filler is drawn off thru the pipe seen in the photograph. The men catch the hot filler in the pails and pour it into the joints as shown. An improved machine, now under construction, will connect the mixer directly with the tar heater so that the fluidity of the mixture can be controlled better. In this machine the mixer axis will be turned by a gasoline engine. The mixer saves the labor of five men ordinarily used. The pails are round with a triangular pouring lip or chamber on the front so that the filler can be poured directly into the joint with but little spreading over the surface of the blocks, as may be seen in the cut.



HEATER FOR DRYING AND HEATING SAND FOR FILLER.

THE COMPLETED PAVEMENT ON SUNDAY. COMPARE JOINTS AND SURFACE OF THE NEW PAVEMENT LAID UNDER THE LATEST IMPROVED SPECIFICATIONS WITH OLD GRANITE BLOCKS IN THE STREET CAR TRACKS LAID SEVERAL YEARS AGO UNDER THE OLD SPECIFICATIONS.

The first pouring of the joints fills them full, but a gradual flow to the bottom of the joints, and perhaps into the sand cushion, with some contraction or cooling, make a second pouring necessary, when the joints are filled full to overflowing slightly.

The completed street is shown in one photograph, taken on Sunday, which shows the special conditions met with, excepting that the traffic is practically nothing.

H. H. Schmidt is the chief engineer of highways of Brooklyn, and E. D. Rhame is the division construction engineer in direct charge of the work. The Charles A. Myers Contracting Co., of Brooklyn, are the contractors.

A SUCCESSFUL MUNICIPAL LIGHTING PLANT

Some time since a description of the new municipal lighting plant of Crawfordsville, Ind., was published in MUNICIPAL ENGINEERING. The plant has passed thru some difficulties on account of failure of the appropriating authorities to provide promptly for necessary construction and extensions, but they were ultimately provided and the report for the year ending with June, 1916, shows that the plant is now operating efficiently and economically.

Most of the commercial service is metered, the receipts from such lighting service being $40,584.75 and for power $22,404.23. Flat rate services amount to only $1,996.27.

The city is charged $13,296.58 for municipal light and other utilities paid $4,150.65 for power service. Other income from merchandise and labor on installations, interest and rents brought the entire receipts to $85,958.58.

Expenditures are $20,143.05 for operation and maintenance of the steam power plant; $1,059.11 for maintenance of the transmission and transformation service; $1,777.54 of the distribution service; $1,737.24 of the consumption service; $578.67 of the commercial service; $5,292.14 general expenses, largely salaries; $1,594.13 for undistributed items, such as injuries and damages, insurance, stationery and printing, stores, automobile and wagon, the two last taking over half the total of the items. The expenditure on buildings and ground was $74.60; depreciation was charged at $12,000 and interest on bonds was paid, $3,036. The total expenses were $47,272.49, which is 55 per cent. of the income.

From the net profits $8,677.95 was paid for construction and equipment.

The cash on hand amounts to $33,650.20 in the general fund, $6,122.02 in the sinking fund, $20,228.81 in the depreciation fund.

The steam plant burned 8,957 tons of coal to produce 3,114,400 kw. hr., or 5.7 per pound of coal, costing 1.4 cents per kw. hr. generated.

The peak load of 1,050 kw. occurred at 8:35 a. m., March 22, 1916. The maximum daily load was 11,350 kw. on February 4, 1916, and the minimum was 3,000 kw. on July 11, 1915.

The number of consumers is 1,945, an increase of 143 during the year.

Receipts increased $11,557.45.
Expenses decreased $744.75.
Current generated increased 1,033,222 kw. hr.
Coal burned increased 1,859 tons.
Coal burned per kw. hr. decreased 1 pound.
Peak load increased 300 kw.
Maximum daily load increased 4,750 kw.

Originality in Street Lighting Standards

By Albert Marple, Tropico, California.

If the designs are artistic, distinctive light standards may add much to the beauty of the city streets as well as give a special point of interest to the visitor or traveler to remind him of it when he is telling other visitors where to go. The same idea is carried into the marking of transcontinental lines of automobile travel. This brief article shows what the birth-place of the idea is doing in the way of emphasizing the trade-marks of its towns, if we may be permitted to use a commercial term.

IT IS probable that nowhere in this country is so much originality exhibited in the street lighting line as there is in Southern California. The officials of the various cities seem to be trying to outdo one another in presenting ornamental electroliers for both business and residential streets, and some very attractive lighting features have been devised and constructed ,which enhance the individuality of the particular cities and towns.

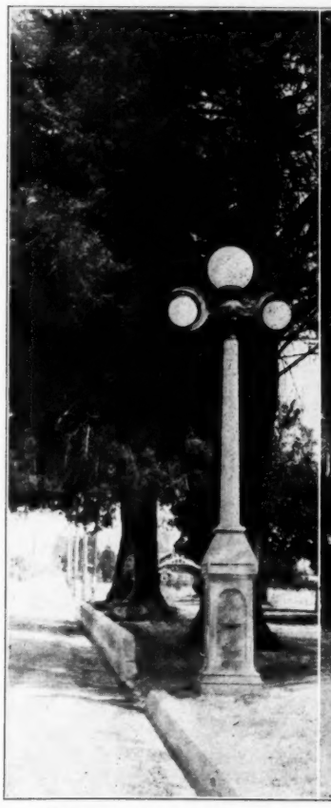
So distinctive are a great many of these lighting standards that places are referred to as having this or that kind of lighting posts. They are in reality new landmarks by which the towns are known. Many of the cities of Southern California have nick names, and in nearly every case the electroliers are designed to suit the nick-name in some way or other. For instance, San Bernardino is known as "The City of the Arrowhead," and the lighting standards of that place resemble as nearly as possible regular arrowheads. Riverside is called "The Mission City." The electroliers of that place are built along Old Mission lines, with their crosses, square corners, bell-shaped globes, etc. Alhambra is known as "The Crescent City," and in the lighting fixtures of that city one or more crescents have been incorporated.

The accompanying illustrations serve to illustrate what is being done along this novel electrolier line. The two first illustrations show two attractive arrow standards in San Bernardino. The standard in Figure 1 is located in the business section, while the one in Figure 2 is one of a series of a hundred or more located along one of the principal residential streets. The Riverside Mission standard is shown in Figure 3, while Figure 4 shows the attractive crescent electrolier to be found in Alhambra.

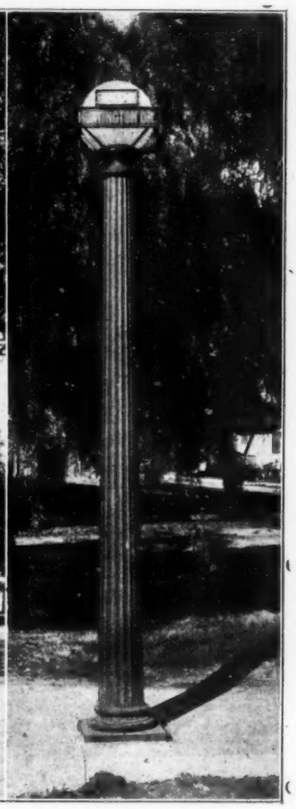
In Bairdstown may be seen the fixture shown in illustration No. 5, which serves three distinct purposes at one time. In addition to being a street light, it shows the name of the street and the block number. Another electrolier along this

THE ARROW-HEAD DESIGN USED ON BUSINESS STREETS IN SAN BERNARDINO, CAL.

THE ARROW-HEAD DESIGN AS USED ON RESIDENCE STREETS IN SAN BERNARDINO, CAL. ADDITIONAL LAMPS CAN BE USED TO OUTLINE THE DESIGN WHEN SPECIAL ILLUMINATIONS ARE MADE.



THE DESIGN USED IN THE CRESCENT CITY, ALHAMBRA, CAL.

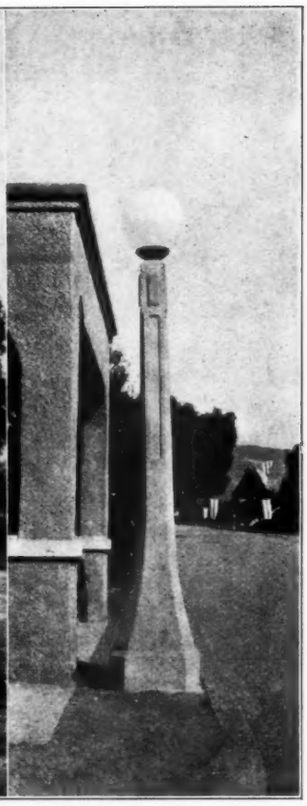


THE BAIRDSTOWN, CAL., DESIGN COMBINES BEAUTY WITH USEFULNESS, AS IT ILLUMINATES NOT ONLY THE STREET, BUT ITS NAME AND THE NUMBER OF THE BLOCK.

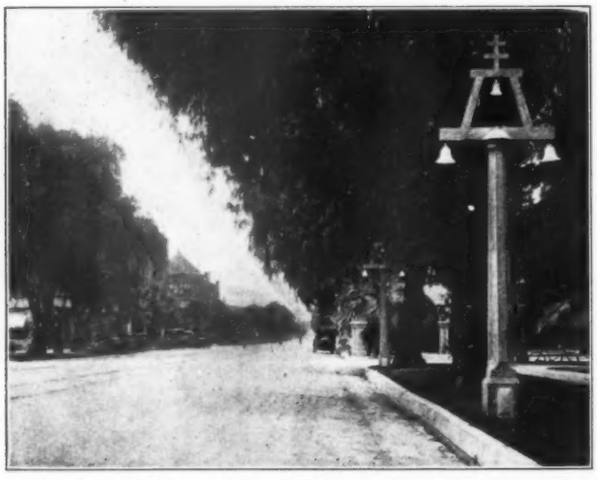
PASADENA'S LAMPS ARE SET AT FREQUENT INTERVALS ALONG THE BLOCKS AS WELL AS AT STREET CORNERS, AND EACH SHOWS THE NUMBER OF THE HOUSE BEFORE WHICH IT STANDS.

UPLAND, CAL., HAS A DESIGN WHICH IS DISTINCTIVE, BUT NOT SO WELL ADAPTED TO USE ON A STREET-LIGHTING POST AS MOST OF THE OTHERS SHOWN.

THE DESIGN OF THIS CONCRETE POST, IN USE AT CULVER CITY, CAL., IS LESS DISTINCTIVE THAN OTHERS SHOWN, BUT STILL IS SUFFICIENTLY DIFFERENT FROM OTHER POST DESIGNS TO BE EASILY RECOGNIZED AS INDIVIDUAL TO THE CITY.



SAN FERNANDO'S SPECIAL DESIGN IS ALSO ON GENERAL LINES, BUT THE FLARING BASE GIVES IT AN INDIVIDUALITY WHICH ATTRACTS ATTENTION, PERHAPS BECAUSE IT IS RATHER HEAVY FOR ITS PURPOSE. IT IS BUILT OF CONCRETE.



THE MISSION DESIGN, WHICH IS DISTINCTIVE IN THE STREET-LIGHTING SYSTEM OF RIVERSIDE, CAL.

line is the one in photograph No. 6, found in Pasadena. This standard shows the number of the house before which it is located, so that the person driving along the street may tell without alighting just where the house that is being sought is located. There are several of these standards between corners as well as at the street intersections. A pretty little standard built on the Mission line is shown in Figure 7. This is located at Upland. It is entirely of concrete, and represents an arched bridge with a series of arches forming the rail. Another all-concrete standard is shown in illustration No. 8. This is located at Culver City and is one of a series of about a hundred. The last illustration, Figure 9, shows an artistic concrete standard located at San Fernando. Standards of this type line both sides of this street and add greatly to its general appearance.

No one has a monopoly on the unique ideas that may be incorporated in the lighting standard, and for this reason it is possible for each city to have electroliers which will, in addition to serving as supports for street lights, have the effect of adding attractiveness to the city in general.

WORKERS IN THE FIELD

"Miracles" vs. "Mysteries" in Highway Construction

Editor of MUNICIPAL ENGINEERING:

Sir—In Mr. Reed's interesting discourse on the "Mysteries of Concrete Road Construction," published in your issue of July, he resorts to rather biting sarcasm to emphasize his views. He makes it clear, however, that in spite of two national conferences on how to build concrete roads, unanimity of opinion is still lacking.

The following paragraph relating to a single feature of concrete road building discloses the present status of affairs:

"There you are! Suspended, mentally dangling in the air, even on the question of joint protection plates. We don't appear to know what we know when we know it."

Mr. Reed concludes with the following statement:

"The answer to all my seven listed mysteries is concentrated in this: Lack of thoroness in the American people—plus short-sightedness of the cement manufacturers in not more actively discouraging inferior workmanship. Because of said short-sightedness and the cement manufacturers' frequently evidenced disposition to boost the price of cement, I sometimes wish there was an open season for cement manufacturers."

But a careful analysis of the paper shows that Mr. Reed, like those he criticises, is obliged to fall back upon that small but very significant word "if." Why does he say "if a cement-concrete pavement could be constructed so as not to develop any cracks," etc. If road-builders of Mr. Reed's experience, keen perceptions and analytical mind are still in the "if" stage of the game, what can be expected of the average county engineer or contractor who essays to build his first concrete road? Mr. Reed is surely mistaken in charging cement manufacturers with failure to discourage inferior workmanship. On the contrary, they have exerted every effort to bring the concrete road to a state of perfection. They have provided free inspection, and on two occasions have called together in national conference all of the concrete road experts of the United States. What more can they do?

But Mr. Reed's paper does present one very important fact. Concerning a concrete road built under his supervision, he says it became "infamously" known as a deplorable failure, and he continues as follows:

"And yet—and herein is one of the allurements of a cement-concrete road, which is always on tap—we charitably hid its shame by humanely spreading a sheet of asphalt over the residue. And lo! there was a metamorphosis to a No. 1 sheet asphalt pavement. That's a miracle which can't be successfully performed on any other type of disintegrated pavement."

In this one paragraph Mr. Reed has laid bare the supreme folly of road-builders in departing from definitely ascertained and satisfactory results to wander in the bogs of theory and conjecture.

What are some of these results?

The street that bears the heaviest traffic in the world is the Thames Embankment, London. It is simply a solid old stone thorofare, with a wearing surface of natural asphalt macadam, the latter put down in 1906. As stated, this street sustains the heaviest traffic in the world.

The Thames Embankment ten-year test of the durability of an asphalt macadam wearing surface is convincing.

Few thorofares carry more traffic than Riverside Drive, New York. It is merely 6 inches of concrete, with a 3-inch wearing surface of asphalt concrete.

Riverside Drive shows what concrete will sustain when used as a road base or foundation.

But for economic reasons we cannot provide newly-constructed country roads with the thick stone base of the Thames Embankment. Neither should we give country roads a 3-inch wearing surface of asphalt concrete. But we can use the concrete base of Riverside Drive and place thereon the asphalt macadam wearing surface of the Thames Embankment. We can increase or diminish the thickness of either to meet varying requirements of traffic.

A sections of the Belair road leading out of Baltimore was constructed in this way in 1914, including concrete curbs as an integral part of the base, the latter 4 inches thick. The road carries excessive traffic to and from Baltimore, and thus far has cost nothing for repairs.

Monroe county, Michigan, is building the same type of road, with the base increased to 5 inches.

The streets of Newton, Kans., were constructed in this way, and some of them have been under traffic for ten years without necessity for repairs.

Philadelphia's great Northeast boulevard has roadways of the same type.

Notwithstanding the demonstrated efficiency of these highways, in which the concrete does not crack, heave or buckle, hundreds of thousands of dollars are being expended in the effort to force it into the strained position described by Mr. Reed.

Furthermore, the cost of the composite type of road is lower than some states are paying for water-bound macadam. The Michigan road contract was let at less than $12,000 per mile. Even Northeast boulevard was constructed for approximately the same price.

Mr. Reed might have presented an eighth mystery—why the engineers and taxpayers of the United States continue to spend money in experimenting with a type of road costing more than those described, and which, even if successfully built, will not, as Mr. Reed says, meet every requirement of traffic, owing to "lack of resiliency," something highly essential where horse traffic prevails.

Mr. Reed's proposed remedy, "an open season for cement manufacturers," is a poor one. They are to be commended for developing the best road foundation material extant.

What is really needed is a closed season for common sense; in brief, a return to the intuitive perception of the fitness of things that induced the cement manufacturers themselves to first oppose all-concrete roads and which led Mr. Reed to cover his disintegrated concrete road with asphalt—treatment to which the concrete responded with such admirable results that he proclaims it a "miracle."

Let us substitute miracles for mysteries.

DANIEL T. PIERCE.
Barber Asphalt Paving Co.

Cost Data for Asphaltic Macadam Pavement by Day Labor

The Editor of MUNICIPAL ENGINEERING:

Sir—The following cost data are for an asphaltic macadam pavement laid by our own street force under the suprvision of the writer. The pavement was laid on an old macadam base and was 2½ inches thick after rolling. No grading was necessary but the fine stone used contained about 75 per cent. dust and it was necessary to screen all this stone before placing same on road. All the stone was loaded with shovels, which accounts for the high cost of hauling it.

Aztec asphalt was used for the binder.

G. C. BREHM, City Engineer,
Waynesboro, Pa.

Docks to Be of Concrete

On and after July 15, 1926, all docks in Chicago must be constructed of concrete. In the meantime the wooden docks at present in service may be maintained where in good condition.

Repairs to present docks can be made by submitting detailed plans for the work to the commissioner of public works and having these plans approved. The commissioner of public works may, in his discretion, refuse permits for repair of docks and require their replacement with concrete

The ordinance contains no specifications for concrete docks, but it is the intention of the department of public works to draw up general plans to which all docks must conform, but which plans will be sufficiently flexible to provide for any special conditions that may arise.

Garbage Collection and Disposal in Springfield, Mo.

The inefficiency of the ordinary contract for collecting garbage without control or provision for disposing of the collected garbage is shown again by recent experience in Springfield, Mo., where the contractor, who was paid $650 a month for the work, was enjoined from disposing of the garbage because his method produced a nuisance. The city officers have not yet recognized the necessity of providing a sanitary method of disposing of the refuse of the city, as it is again proposed to let a contract for the collection alone.

COST-DATA 6122 SQ.YDS. ASPHALTIC MACADAM BY DAY LABOR AT WAYNESBORO, PA. By G.C. BREHM City Engr

UNIT	AMOUNT	RATE	TOTAL COST	SQ.YD.	TOTAL SQ.YD.	REMARKS
3" and 2" STONE	636.2 tons 20.5 "	.90 .80	643.30	.10508		
HAULING	505	.50	252.50	.04124		One Mile
SPREADING	295	.16	47.20	.00770		
ROLLING	74	.25	18.50	.00302		
COAL	2500 lbs.	.002	5.00	.00081		
OIL	1½ Gal	.50	.75	.00012		
SUPERVISION			15.00	.00245	.16042	
ASPHALT	13507 Gal.	.061	823.93	.13458		
HAULING	53 58	.50 .16	36.78	.00584		
APPLYING	108 342 333	.20 .18 .16	167.80	.02740		Pouring Cans
WOOD	6 Cord	6.00	36.00	.00588		
OIL and Waste	27½ gal. 15 lbs.	.12 .15	5.55	.00090		
SUPERVISION			60.00	.00980	.18440	
1" and ¾" STONE	99.2 tons	.90	89.28	.01458		
HAULING	83	.50	41.50	.00678		One Mile
SPREADING	139	.16	22.24	.00363		
ROLLING	20	.25	5.00	.00081		
COAL	1500 lbs.	.002	3.00	.00049		
OIL	3 qts.	.125	.37	.00006		
SUPERVISION			8.00	.00130	.02765	
½" STONE	49 tons	.90	44.10	.00720		
HAULING	51	.50	25.50	.00418		One Mile
SPREADING	123	.16	19.68	.00321		
ROLLING	15	.25	3.75	.00061		
COAL-OIL and SUPER.			9.35	.00152	.01672	
MISCELLANEOUS			121.00	.01978	.01978	Dep. Machinery Clean Up Etc.
TOTAL			2,504.08		.40897	

FIRE DEPARTMENT

Fighting Fires in Early Chicago

We are indebted to Mr. Francis A. Eastman, City Statistician, city of Chicago, for the following information relating to fire fighting in Chicago in the early days.

The first fire ever reported in a Chicago newspaper broke out on October 11, 1834, at the corner of Lake and LaSalle streets. Three dwelling houses, a grocery store and a cabinet shop were destroyed. By that event the Board of Trustees was moved to take further action; they held a meeting, in which the citizens generally participated, and passed an ordinance declaring that thereafter it would not be lawful for any person or persons to carry firebrands or coals of fire from one house or building to another within the limits of the town, "unless the same be carried or conveyed in covered earthen or fireproof vessel, under penalty of $5 fine for each and every offense." Complaint was made at the meeting that there was not a fire-bucket in the place. On September 19, 1835, the trustees resolved to order two fire engines for the use of the corporation, "of such description as the president of the board should deem necessary, and also one thousand feet of hose, on the credit of the corporation." The president gave over the duty and responsibility of making the purchase to William B. Ogden, as agent. A month later the trustees ordered the buying of two fire-hooks, with chains and ropes, two ladders, sixteen feet long, four axes and four hand saws. Such articles were bought at the cost of $26.63. Thereupon a hook and ladder company, consisting of twenty-five citizens, was organized. In the list of names of members are found a number that afterward became distinguished in the city of Chicago and beyond. On November 4, 1835, the trustees adopted measures for the organization of a regular fire department, to consist of a chief engineer, two assistant engineers, four fire wardens, in addition to the trustees, who were designated as wardens ex-officio.

"Self-Propelled" Apparatus in 1877.

Some time in 1877 the fire department invested in self-propeller machines, which, attached to fire engines, made havoc on the streets, tearing up pavements, running into other vehicles, and crashing against lamp-posts. There were three such purchased and put in use; two on the West Side, one on the South Side. The wheels were shod with thick steel bands stuck full of spikes, to prevent skidding. But in that case prevention did not prevent; at the speed they were driven, when turning a corner, they skidded frightfully. Finally one of the self-propellers struck against the head of an old wooden bridge that stood at Adams street, and did to the bridge and itself much damage. Then all were put out of service. But they had anticipated or predicted the auto-truck of the present day.

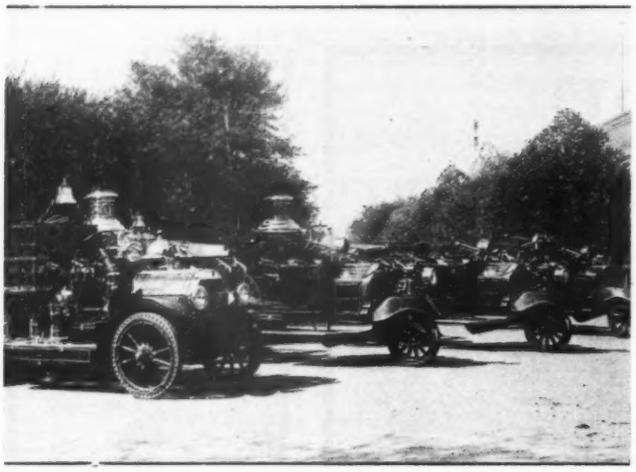
In 1893 the fire department comprised four fire boats, eighty steam fire engines, three hand engines, twenty-six chemical engines, one hundred hose carts, carriages and wagons, thirty-one hook and ladder trucks, sixty chemical extinguishers, thirty-one portable pumps, and one water tower. The uniformed force was nine hundred and eighty-four; not uniformed forty-six, making a total of one thousand and thirty-seven men in the fire service. Of horses, there were six hundred and sixty-six.

Record for Year 1914.

During the year 1914 the fire department responded to 14,977 alarms and the number of actual fires for the same period amounted to 10,534. There were a few fires of considerable magnitude from a spectacular standpoint, and where the energies of the firemen were thoroly taxed, but the financial losses were not great comparatively, such as the U. S. Express Stables April 17, involving a loss approximately $190,000; another, May 27, where the loss approximating $35,000, was inconsiderable compared with the area burned over and number of communications, and the fire on Christmas Eve in the department store at Forty-seventh and Ashland avenue,

(Courtesy of "Popular Mechanics.")

HARLEY-DAVIDSON & PYRENE SIDE-CAR FIRE FIGHTING DEPARTMENT OUTFIT.



OKLAHOMA CITY MOTOR FIRE APPARATUS EQUIPPED WITH GOODYEAR TIRES.

which, with the smaller buildings it communicated to, approximated a loss of $225,000.

The forces of the department for the year 1914 were the fire marshal and six assistant fire marshals, 159 chiefs of battalions, 159 captains, 162 lieutenants. The total numerical force was 1,988 men, officers and privates. The aggregate cost of the department was $3,461,584, or $1.43 per capita.

There were transmitted during the year 3,333 box alarms, 102 second alarms, 26 third alarms, 34 combined second and third alarms, 47 special calls and 11,435 still alarms, making a total of 14,977 alarms, an increase of 294 over the preceding year.

New Fire-Fighting Motorcycle

In this issue we are illustrating a Harley-Davidson-Pyrene motorcycle for fire department usage. This outfit forms a very efficient piece of fire-fighting equipment for small towns and villages. It is also a valuable auxiliary for the proper equipment of fire-houses of the largest cities.

Such a unit can be shot out on telephone calls, thus saving wear and tear on heavier types of apparatus.

Statistics show that thousands of fires would be confined to curtains, couches, closets or similar limited areas if something could be done at once to check the flames. The motorcycle fireman not only is able to get away from the house faster, but can make up minutes of precious time thru congested traffic, where the larger apparatus would have to slow up frequently in the course of a run. That's making the most of the seconds.

Towns depending on volunteer departments for protection realize the shortcomings of that sort of service. With this outfit it is not necessary to wait for the required number of men to haul the apparatus to the scene of the blaze or to waste precious moments looking up a team. One man can hop onto the motorcycle equipment and pick up aid en route or at the fire and thus insure giving the fire a fight in the early stages and not after it has reached the "beyond control" period.

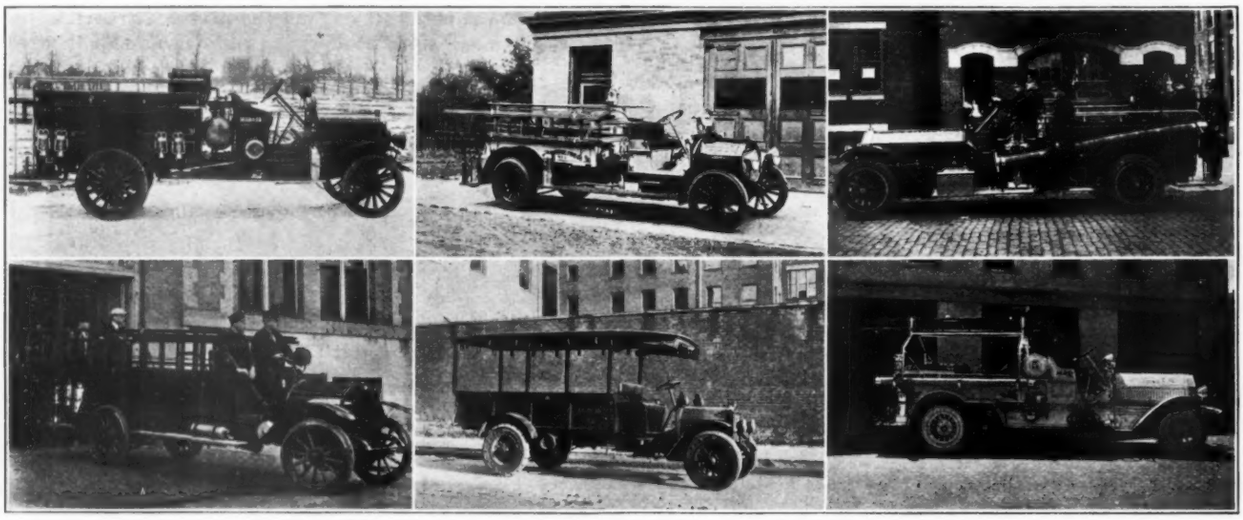
A Popular Priced Outfit

The village of Galeton, Pa., has recently placed in service an American-La France combination hose and chemical truck (Ford chassis). The truck is equipped with a twenty-five gallon brass chemical tank, to which is connected 100 feet of chemical hose. The rear body is built to hold five hundred feet of regulation fire hose. On the sides hang the fourteen foot extension ladder, the lanterns, hand extinguishers, axes, etc. The price of the apparatus is $1,300.

A Brockway for Guayaquil

Guayaquil, Ecuador, has an efficient fire-fighting force well known thruout South America. It is equipped with the most modern American apparatus, against which no fire of recent years has been able to make serious headway.

Recently another engine was landed here, of the automobile Brockway type, with 800 feet of hose, having a 4-cylinder motor of 35 horsepower. It is provided with a chemical apparatus of 25 gallons capacity, and 200 feet of hose, ejecting a stream of liquid 30 feet, together with two 3-gallon hand



RECENT DEVELOPMENTS IN MOTOR FIRE APPARATUS.

SERVICE HOSE, CHEMICAL SQUAD WAGON, CITY OF WABASH, IND.

JEFFERY 1½-TON COMBINATION (WITH LADDERS). CITY OF MINNEAPOLIS, MINN.

GARFORD COMBINATION (WITH LADDERS), CITY OF WOODBRIDGE, N. J.

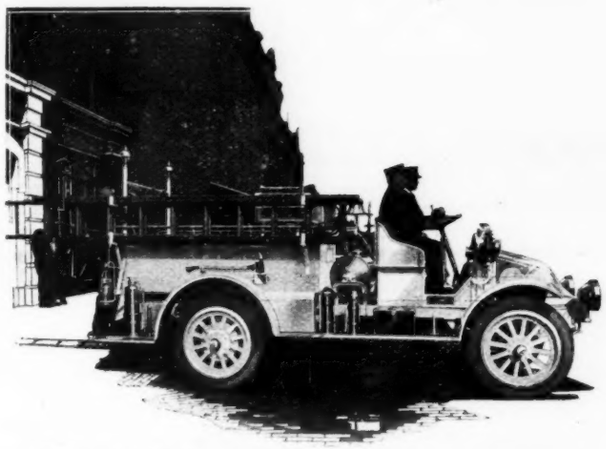
FEDERAL SERVICE TRUCK. STANDARD EXPRESS BODY. NO SCREENS. CITY OF DETROIT, MICH.

BOYD COMBINATION AND SQUAD WAGON, EQUIPPED WITH SEWELL CUSHION WHEELS, CITY OF CAMDEN, N. J.

SEAGRAVE TRIPLE COMBINATION, EQUIPPED WITH SEWELL CUSHION WHEELS. CITY OF PASADENA, CAL.

machines, to be used when the more powerful water stream is not necessary. There is also a full equipment of other apparatus required for the work, including a strong acetylene head light and fire bell.

The machine carries 10 men and has already been placed in the service. It was made at Elmira, N. Y.



TWO NEW KELLY COMBINATION HOSE AND CHEMICAL TRUCKS RECENTLY PLACED IN THE SERVICE OF THE CITY OF SPRINGFIELD, OHIO. THIS MAKES A TOTAL OF FIVE KELLYS IN THE SPRINGFIELD FIRE DEPARTMENT AND TEN IN THE CITY SERVICE.

Preparedness of Motor Truck Manufacturers

We are demonstrating every day that our state of preparedness for any emergency is more advanced than we have been thinking. While the Government itself has been discussing the question and Congress has been delaying official progress toward national preparedness, the demands made upon private business on account of the European war have produced a state of individual preparedness which is marvelous. It is evidently possible at any moment by turning commercial factories into Government needs to supply them as rapidly as the materials can be used.

This is true of practically everything but big guns, war vessels and good roads. These cannot be built after a war begins rapidly enough to be of any early service.

The new law making appropriations for building highways, recently passed by Congress, is the first step toward filling one of these needs. Proper selection of roads in each State for first improvement with Government aid will be the next.

One of the latest evidences of private preparedness is the prompt action of the Packard Motor Car Company of Detroit on an order for 396 motor trucks for the army along the Mexican border and the men to handle them, some 636 in number. This will make more than 1,000 of Detroit young men with the army who have gone since the mobilization order to the National Guard.

TWO KELLY HOOK AND LADDER TRUCKS IN THE SERVICE OF THE INDIANAPOLIS (IND.) FIRE DEPARTMENT.

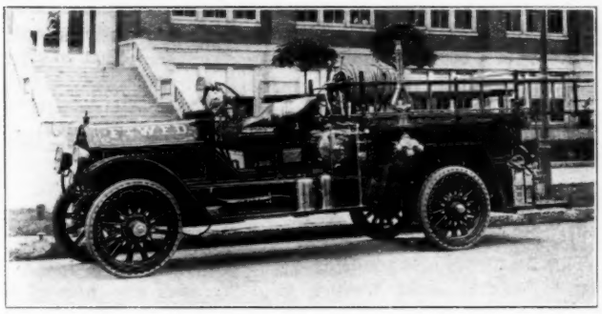
The Packard Company has already furnished 122 men for government service, tho not enlisted in the army, to operate 122 trucks, which they have sent for use in Mexico since March 22, and 109 of the company's men have mobilized with the Michigan section of the National Guard. The naval militia call will take some more.

The 636 men required for the new order for trucks will form complete transport companies, and will be civilian employes of the United States under a year's contract at $100 a month and transportation. The company has issued a call for these men and they are coming in as rapidly as the trucks are ready to turn over to the Government. Some young men refused enlistment in the army on technical grounds or for minor deficiencies are acceptable for this truck work.

Another South Bend Double Duty Combination Delivered

The South Bend Motor Car Works of South Bend, Ind., has recently delivered to the city of Ft. Wayne, Ind., a type "60" Combination Chemical and Hose Carrier.

This piece of apparatus is equipped with a 60-horse power



motor and is of the worm drive type. It is equipped with step type fenders, three-way turret pipe, 40-gallon chemical tank, 250 feet of 3/4 four-ply chemical hose, 1,200 feet hose body and all other standard equipment. It will be noted that this car was delivered on Goodyear Cushion Tires.

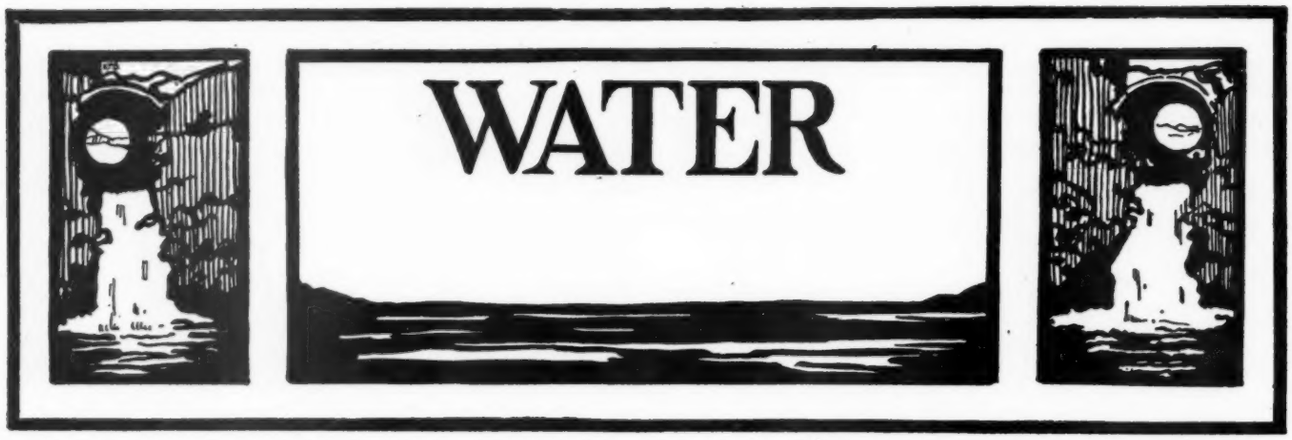
The South Bend Motor Car Works would be pleased to give any one any further information desired on this car.

Garford Worm-Drive Trucks

Garford 1½ or 2-ton worm drive trucks are made with just the simple hose-carrying body, with space of 20 men; with the same body with one or two chemical tanks; the same with a powerful pump attached. These machines have found favor with the fire departments in suburban communities, where the distances are great. On Long Island, for instance, six of these Garford motor trucks thus equipped are in use and other towns are expecting to add these efficient machines to their fire departments immediately. There are two at Port Washington, one each at Oyster Bay, Syosset, East Norwich and Roslyn. Westchester County has two—at Katonah and Mount Kisco—and many other towns around New York are just on the eve of buying.

Property Owner Must Pay Expense of Putting Out Fire

The European principle of fining a property owner if he has a fire on his premises has been established in Brooklyn, N. Y., for the first time in this country. The owner of a building had been notified to instal a sprinkler system, had failed to comply with this fire department order and he had a destructive fire. The commissioner sued for the cost to the fire department of putting out the fire and obtained judgment for $1,500, the estimated cost.



Rapid Sand Filters in Ohio

Experience indicates that the rapid sand filter is best qualified for the purification of the comparatively turbid waters found in the Middle West, and in a paper before the Central States Water Works Association, Philip Burgess shows what an important part in the development of the history and art of water purification rapid sand filters have played in the state of Ohio.

A patent for the use of a coagulant in connection with the filtration of water was granted to J. L. Hyatt in 1884, marking the beginning of the development of rapid sand filter plants for the treatment of municipal water supplies and the first of such plants was constructed in the United States at Somerville, N. J., in 1885.

The first rapid sand filter plant constructed in the state of Ohio was built at Warren in 1895, and was one of the type covered by letters patent issued to J. E. Warren in 1889.

The first rapid sand filter plant in the United States provided for the purification of a municipal water supply and constructed under a guarantee of efficiency was contracted for by the city of Lorain, Ohio, in May, 1896, with the O. H. Jewell Filter Co.

The first municipal water softening plant constructed in the United States was built at Oberlin, Ohio, in 1903, and rapid sand filters of the pressure type were used to filter the softened water.

The largest municipal water softening plant in the world and the second largest rapid sand filter plant in the world are constructed at Cleveland, Ohio, with a capacity of 144,000,000 gallons daily.

The third largest rapid sand filter plant in the world, also, is in Ohio, at Cincinnati, and has a capacity of 112,000,000 gallons daily. Moreover, the Cincinnati filters were the first municipal filters designed for the application of wash water at high rates without any other means of agitation for cleaning the sand. In building the Cincinnati filters, a brass wire screen was placed over the gravel to keep it in place during washing.

The first municipal rapid sand filter plant designed for high rates of washing, and constructed with deep, coarse, gravel layers over the strainer systems without super-imposed screens for holding down the gravel during washing was constructed at Niles, Ohio, in 1910.

The first filter plant at which alum has been manufactured for use as a coagulant is at Columbus, Ohio.

The first municipal rapid sand filter plant at which the disinfectant qualities of common lime have been intelligently and knowingly utilized is at Cleveland, Ohio.

The first systematic investigation by a state board to determine the efficiencies of the filtration plants in a state was made by the Ohio state board of health in the years 1906-8.

TABLE SHOWING PROGRESS IN CONSTRUCTION OF RAPID SAND FILTER PLANTS IN OHIO.

Period	Population served by new plants at end of period	Daily capacity of new plants
1895	7,900	1,450,000 Gallons
1896-1900	35,371	7,870,000 Gallons
1901-1905	123,284	24,520,000 Gallons
1906-1910	777,293	179,650,000 Gallons
1911-1915	930,674	236,200,000 Gallons
Total present daily filter capacity		449,200,000 Gallons
Total population served in 1915		1,940,000

TABLE SHOWING PERCENTAGE OF POPULATION OF STATE OF OHIO SERVED BY RAPID SAND FILTERS.

Year	Total Population of State	Population served	Per ct.
1900	4,157,545	43,900	1.1
1905	4,462,333	185,486	4.2
1910	4,767,121	945,819	20.7
1915	5,071,909	1,940,000	38.3

The total nominal capacity of filters now in operation or under construction in the state is sufficient to provide nearly 90 gallons of filtered water daily for every resident in the state.

Probably the greatest development in the art of water purification has been an appreciation of the fact that the burden to be placed upon the filters should be made as small as possible in order to accomplish the most satisfactory results at the least expense. Within reasonable limits, it is true that the percentage removal of bacteria and impurities by the filters themselves is limited so that, of course, the best results are accomplished by removing all possible impurities by preliminary treatment before filtration. This has been appreciated in the design of modern plants wherein the period provided for coagulation and sedimentation previous to filtration is frequently from three to six hours.

In the same way, there has been a marked development in the design of the filter tanks themselves. The phrase "mechanical filters" frequently applied to rapid sand filters, was derived from the fact that a stirring device, or mechanical agitator, was provided to stir the sand in the filters and thus to assist in the removal of impurities during washage. It is obvious that such a device required a circular filter tank. As early as 1889, it was recommended that air under pressure could be used to agitate the filter sand during washing and the application of this principle, of course, permitted the use of rectangular tanks in place of the circular tanks as previously required with mechanical agitators or rakes. This principle has proven of great value in reducing the construc-

tion cost of the larger mechanical or rapid sand filters, because it has permitted the use of reinforced concrete, rectangular units occupying very much less area than is required for circular tanks of the same capacity.

It is significant of the development of the art of water purification that the last wooden sand filters now operating in Ohio and provided with mechanical agitators very soon will be removed and replaced by rectangular concrete tanks. The old filter tank at Lorain was replaced some years ago by a modern concrete filter plant, but the results accomplished by the modern plant today are no more satisfactory than the results which were accomplished by the old plant before its capacity was exceeded. Moreover, the cost of operation of the new plant is considerably in excess of that of the old plant.

In view of the disadvantages apparent in the closed type of strainer system comprising perforated pipes equipped with sand screens, or valves, engineers have endeavored to develop a strainer system of the closed type in which all parts would be accessible. The first strainer system developed along these lines in Ohio was used at Cincinnati and comprised lateral concrete channels covered with perforated brass plates. The design permits the removal of the plates and inspection and cleaning of all parts of the strainer system. Owing to construction imperfection, especially at the shoulders where the brass plates are supported, some engineers have reverted to the original form of closed or pipe strainer system. Possibly this action has been taken in part because of patents covering the use of depressed channels in filter bottoms.

A further important modification in the design of rapid sand filters was developed at Cincinnati and comprised the use of wash water without either air or mechanical agitation for cleaning the sand. Experiments conducted by Mr. J. W. Ellms indicated that when the wash water was applied at rates greater than 18 inches vertical rise per minute the entire sand body was thoroly agitated and moved by the wash water, so that further agitation by mechanical means or by air under pressure was not required. It was thought at that time that the high velocity of the incoming wash water would require that the filter gravel, placed above the strainer system, be restrained in place by brass screens. Subsequent developments, however, have shown that the screens are unnecessary and during the past two years they have been removed and the gravel layers deepened.

This fact was appreciated in the design of the rapid sand filter plant constructed at Niles, in 1910, under the direction of the speaker, where wash water is applied at a rate of about 24 inches per minute without any disturbance of the filter gravel, which consists of coarse, deep layers not fastened down by screens.

In this connection it may be noted that not the least important development in the design of rapid sand filters has been in connection with the use of larger and deeper gravel layers. In the old Warren and Jewell type filters, such as were built at Warren and Lorain, Ohio, no gravel whatever was placed between the strainer systems and filter sand. This method of construction in fact was continued for a number of years, and until 1910 some filter plants were constructed without any filter gravel. The speaker has known instances where the construction of old filters has been modified by placing gravel above the strainers with the result that much more efficient washing of the filters has been accomplished by the use of very much less wash water. It is undoubtedly true that the gravel layers play an important part in distributing the wash water thruout the filter area, as well as in keeping the sand from passing thru the strainer system, so that the successful washing of filters, especially under high rates, may be largely attributed to the use of coarse, deep, gravel layers.

A considerable part of the expense of operating a rapid sand filter plant is in the necessary coagulant, that most commonly used being filter alum, or aluminum sulphate, which generally is purchased in crystalline form at a cost of about 9 cents per pound. To Mr. Hoover, chemist in charge of the Columbus, Ohio, softening and rapid sand filter plant, belongs the credit for introducing the manufacture of the filter alum directly at the plant. The alum manufactured at the Columbus plant is not filtered or crystallized, but is applied in the crude liquid form. It is obtained at less than one-half the cost of the finished manufactured product and, on account of the fine clay contained in the liquid, has proven even more efficient than the clear crystallized chemical.

Another notable development in the art of water purification has been accomplished by the introduction of disinfectants or sterilizing agents. The three disinfecting agents which have been used on a large scale to sterilize municipal water supplies are hypochlorite of lime, liquid chlorine and quick-lime, or calcium oxide, and the use of these germicides has become so universal that it is the exception where a filter plant effluent is not treated in this manner. The most common treatments are with hypochlorite of lime, or with liquid chlorine gas.

The municipal softening plant at Columbus, Ohio, has offered unusual opportunities to study the germicidal effect of quick-lime, which is used primarily to soften the hard water of the Scioto river, but which is found also to destroy bacterial life in the treated water by eliminating the carbonic acid which appears to be necessary for sustaining such life. Dr. A. C. Houston, chemist of the Metropolitan Water Board of London, England, probably is the first observer to note such germicidal action in lime.

When enough lime is added to water to absorb the free and half-bound carbonic acid to precipitate the magnesium content, the bacteria of the colon and typhoid group are killed in forty-eight hours after being so treated, provided the water does not contain large quantities of organic matter. The germicidal action is effective in from five to twenty-four hours when an excess of one-half to one grain per gallon is added beyond that needed to reduce the temporary hardness to the lowest possible figure.

Quick-lime has an advantage over hypochlorite of lime or liquid chlorine as a germicide, because its action continues indefinitely so long as the lime treated water contains no carbonic acid, whereas the germicidal action of the hypochlorite continues but a short time after the application of the chemical.

The use of lime to treat and soften Lake Erie water at Cleveland, which has an average total hardness of not more than 115 parts per million, is a radical departure from former current practice, because such water, especially in the Middle West where hard waters prevail, would be considered of satisfactory quality for domestic use without softening. It is reasoned, however, that owing to the considerable difference in cost per ton of quick-lime and of alum, it is possible to use about four times as much lime as alum at the same expense. The lime has a continued germicidal action, especially on intestinal bacteria contained in the water, and moreover, the lime will soften the supply, which will thus be made more desirable at but slightly more expense than would be entailed by the usual methods of filtration, using a coagulant such as filter alum.

No Minimum Gas Rate in St. Louis

The Laclede Gas Light Company, of St. Louis, has filed an amended schedule of rates with the Missouri Public Service Commission, which is the same as one recently filed, except that it withdraws a minimum charge of 50 cents a month per meter.

Antiquated Sewage System

The city of Chicago presents the remarkable spectacle of a world metropolis still attempting to make use of a public utility designed for one-twenty-fifth of its present population. The downtown sewerage system, which was the first comprehensive system of any large city, is now notable as being the most inadequate.

In the fifty-five years since E. S. Chesbrough designed and installed the first and only downtown sewerage system many changes have come about. Prairies and marshes have been transformed into residential and industrial districts. Everything about Chicago has changed but her village charter and her sewers. Both have done good service, but they cannot go on forever.

The public has not appreciated the importance of adequate sewers because they are among our unseen utilities. Dirty streets and overflowing garbage cans call forth loud protest, while larger quantities of filth in an antiquated system of sewers go unnoticed. The menace to health is greatest in the unseen danger.

Changes in the character of the business district and large increases in population have made sewers varying from 2 or 3 feet in diameter in the east and west districts and but 1 foot in diameter in the north and south streets grossly inadequate. All space to-day is either roofed or paved. The sewers receive the entire rainfall.

Following heavy rainfall, the sewers frequently become choked. Heavy manholes are blown into the streets. Basements are flooded with deposits flushed from the mains. Numerous complaints result. Nothing is done and the matter is forgotten until the next occurrence.

The sewers are not self-cleaning. The original streets were about 10 feet below the present streets, and the sewers, in consequence, were given very flat grades. The flow is sluggish and sedimentation inevitable. The sewers are half full of mud and water under the most favorable conditions. In some places water pipes have been built thru the sewers, aiding deposits and making cleaning impracticable.

Grease in large quantities from hotels and restaurants finds its way into the sewers and there deposits. Sewers already outgrown are further handicapped. Many drains have been choked from this cause.

Building operations cause the settlement of adjacent streets. Sewers are stopped up and in some cases broken. Five streets in the downtown district of Chicago are now in bad condition from this cause. An investigation would probably reveal others in an equally serious condition.

The pumping of sewage from the deep basements of modern buildings often flushes the deposits in the main sewer into the drains and basements of buildings of the old type. A situation of this character is not only unpleasant, but results in further damaging the old drains.

While the sewers remained changeless, an intricate system of public utility services has been located thru and around the sewers and catchbasins. These obstructions have crowded out many of the catchbasins and made the cleaning of others impossible.

To recapitulate, the downtown sewerage system is outgrown and inadequate. The city faces subway construction, but before subways are built, plans for a new sewerage system should be provided. It will be possible to build sewers now which will serve the central business district for an indefinite period. The new system should also take into consideration possible changes in present sewage disposal.

Use Panama Lesson in American Cities

By R. H. Bishop, Jr., M. D., Health Commissioner of Cleveland.

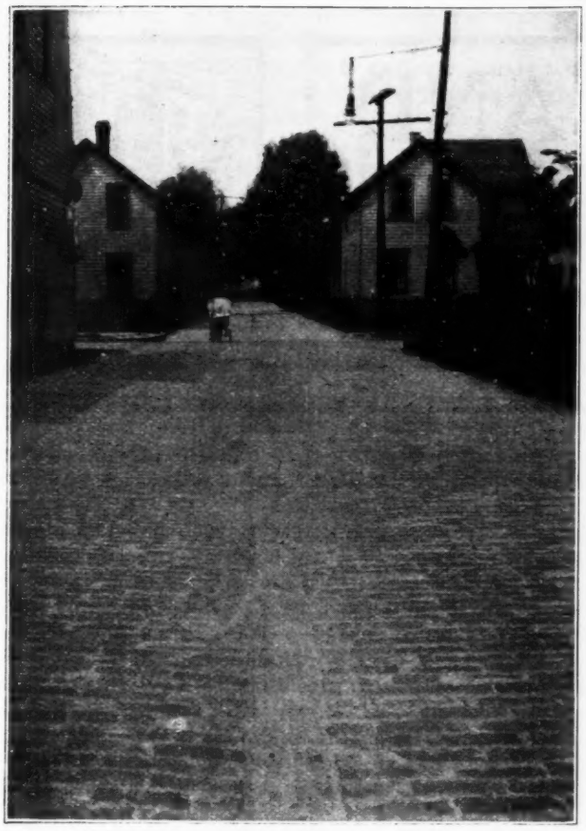
Sanitary administration continually forces upon public officers the question of square dealing as between rich and poor. It is impossible for a health official to go through such a crisis as was forced upon American cities by the epidemic of infantile paralysis without being impelled to consider what is the minimum that any citizen has a right to expect of his local government.

I am convinced that, among other things, he is entitled to clean streets. This means, of course, that he is entitled to street improvements that are capable of being cleaned.

There appears to be no just reason why the best paving should be provided for the streets of the well-to-do or why these streets should receive the major attention from street cleaning departments. Yet this is often the case. From a sanitary standpoint it would be much better to discriminate on the other side, if ther is to be any discrimination at all.

The poorer portions of any city are more crowded. There is little or nothing in the nature of dooryards, so the street is the place where children play and older people congregate in their spare time. Congestion increases the normal refuse that may be expected in a populated region. It is in such localities that we find the cobbled, cracked and rutted pavements, which defy the best efforts of the street cleaner and which often, perhaps thru discouragement over results, the street cleaner so nearly neglects.

Infantile paralysis has been a peculiarly distressing scourge in cities where it has obtained a foothold. The mortality has been high and in cases where recovery takes place there is probability of lifelong physical defects. The germ has defied isolation. It is not known definitely whether it finds entrance to the system thru the respiratory organs or thru the stomach, or both. Insects are reasonably suspected of transmitting infection in many cases. Warfare against such a germ means elimination of every possible breeding place—every channel of access.



A Sanitary Alley Paved with Vitrified Brick with Cement Filler.

The conditions of this warfare are not satisfied when a broom is passed across the irregular surface of some worn-out pavement, leaving the interstices filled with moist and decayed filth. A street ought to be built like a hospital floor, with a uniform, non-adhesive surface, so drained that the application of water from a flusher will wash the smallest particle of filth from its moorings and carry it clear to the sewer without interruption.

The workingmen who make up the population of congested localities deserve the best that the municipality can do for them. The first thing that I would suggest would be the wholesale tearing up and resurfacing of every battered street in the populous districts. It may be objected that better public improvements would be reflected in higher rents and that the poor man would be simply compelled to move. Such a phenomenon was witnessed in New York when Jacob Riis succeeded in leveling tenement houses for the purpose of creating small parks. The park frontage was soon sought by people who could afford to pay higher rent and the worker, whom Riis tried to benefit, was excluded.

What I propose is not quite a parallel case. With a wholesale repaving program there would be little premium, if any, upon residence on a particular street. Paving is the public function most often financed by frontage assessments. It is a principle well established in economics that assessments upon lots, irrespective of the state of improvement, cannot normally be shifted into increased rent upon the tenant.

Dr. Gorgas' work in Panama only became effective after grouted brick pavements had been laid upon practically every street of the city, thus establishing a basis for public cleanliness. It seems to me that many American cities can learn for themselves what the United States has already taught the tropics.

Even if the subject is approached from the narrow standpoint of upper-class interest, the dangers of permitting disease to breed in any portion of a city can readily be seen. To the casual view a slum district may seem isolated. But the prosperous citizen, before he permits himself to become indifferent, should remember that his washing, his delivering and other of his own household functions are performed by persons who may come from congested and infected localities; that his office is cleaned by women of the tenements and that he brushes against persons of all classes on elevators and street cars.

This is the selfish aspect of the case. I prefer to put my argument for cleanable streets on a different basis—that a man is a man and a baby is a baby, whether the home fronts on an alley or a boulevard.

Garbage Collection in Ogdensburg

The Board of Health of Ogdensburg, N. Y., has just let a contract for the exclusive right to collect garbage in the city under the following conditions: Each householder is required to deposit $1 for a garbage can, each to be 22 inches high and 14 inches in diameter. The contractor specified in his bid the amount that he will charge the householder each month to collect the garbage twice a week and the householder is obliged to pay this amount. The cans are carried away by the contractor and replaced by cleanly washed and sterilized cans. The contractor furnishes $500 bond, and the year's contract can be renewed if the service is satisfactory.

Sanitation in New Orleans

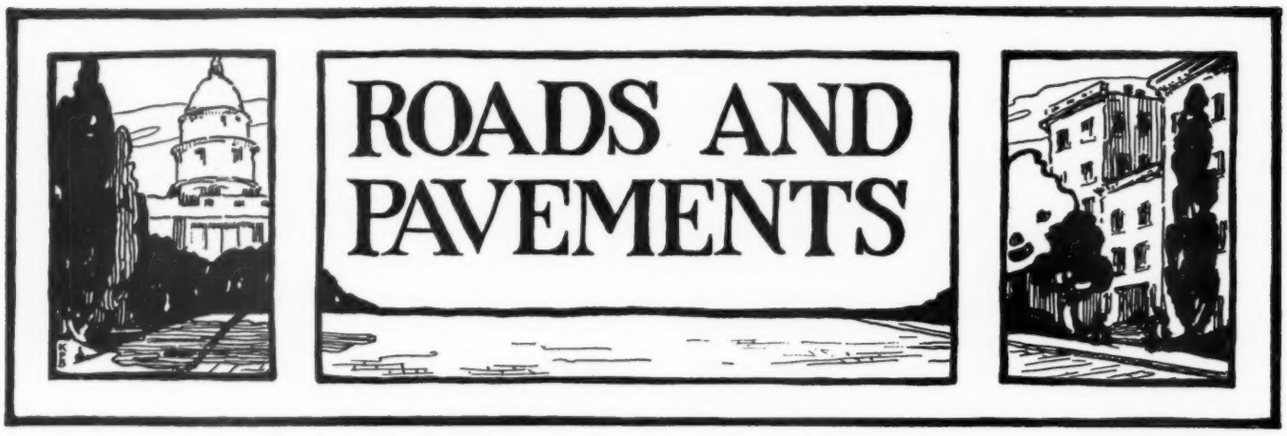
The Board of Health of New Orleans is preparing an ordinance requiring all property owners along the lines of service to connect with them and will abolish all vaults and cesspools. The ordinance of the board, under a new law, will have the same effect as tho passed by the City Council. The law referred to corrects the law previously passed as to penalties and this makes the Board of Health supreme in matters of health. A number of ordinances, including the noted rat-proofing and chicken ordinances over which there was much contest, were declared invalid under the old law and can now be re-enacted. They are essential to the protection of the city against the bubonic plague, yellow fever and the like.

Sewage Disposal for Hermosa Beach, Cal.

The city of Hermosa Beach, Cal., is to construct a sewage disposal plant to protect its beach, in accordance with a resolution passed by the Board of Trustes on August 1, 1916.

The raw sewage will be pumped by two 100-gallon compressed air sewage ejectors, supplied with the necessary electric motors and compressors thru a force main 1,800 feet long against a static head of 43 feet to the sewage treatment plant.

This plant, on the Brosius system of activated and aerated sludge, consists of 8 circular concrete tanks 12.5 feet in diameter and 13 feet deep. It is supplied with electric motor, high-pressure blower and the necessary pipes, and will be covered with an Armco metal building on a wooden frame. After treatment the sewage runs 830 feet in a 12-inch vitrified pipe; thence the pipe and the force main above described run for 700 feet in a timber-lined tunnel 5½ by 7 feet; thence the pipe is a 12-inch re-enforced concrete pipe to the ocean shore; from which the effluent flows in a 10-inch cast-iron pipe laid on the bed of the ocean for 1,300 feet to the point of discharge. The enginer's estimate of the cost is 27,000, and bids will be received about October 15, 1916. C. R. Sumner is the City Engineer.



The Objections to City Paying Total Cost of Street Paving

That Boston streets never will be properly paved until a large part of the cost of putting each street into proper condition is assessed against the property owners in each thorofare so improved, and that the chief reason of the city's lack of funds for this work is "inadequacy of the legal machinery under which it is operating," are assertions made in an interview with George C. Warren, president of Warren Brothers Company, general contractors.

Mr. Warren declared that it is a proposition which cannot be successfully contradicted that cities which pave with city funds entirely have the poorest streets in the United States, while those which assess all, or part, of the costs of paving upon the abutting properties are provided with the best.

He said that Boston is getting nowhere in its endless discussion between mayor, council, finance commision and other organizations. He declares "the arguments being put forward have every appearance of being made for the mere purpose of obtaining some political advantage rather than to benefit the deplorable condition of the streets."

"Something constructive," is the need in Boston now in handling the street-paving problem, Mr. Warren insisted. He said:

"It may be that some saving can be made in the operation of the several city departments which would allow in the future a larger expenditure from current revenue on the streets, but it can be asserted without fear of successful contradiction that the aggregate of all such items will not be sufficient to afford any adequate remedy.

"The real trouble with the streets of Boston is due to the lack of sufficient available funds to properly construct and maintain suitable street surfaces, and the reason for the lack of funds is the woeful inadequacy of the legal machinery under which the city is operating.

"The company with which I am connected is doing a large paving business thruout the United States and Canada, and I have therefore been in close touch with the laws and practices of many cities in the matter of the paving of streets. It can be stated as a maxim that the cities which pay for their street pavements from the general funds without assessing any portion of the benefits upon the property abutting on the improvements are the poorest paved and that conversely the cities which assess a large part of all of the cost of street pavements against the property benefited are the best paved.

"The law under which Boston is operated provides that when a new street is opened a portion of the cost may be assessed against the abutting property, but after such street is accepted, the maintainance thereof must be paid by the city from its general funds. For many years and until quite recently, it has been the practice of the city to accept new streets without requiring that they be adequately paved, with a result that within a few months the pavements must be reconstructed and the expense of reconstruction and maintenance becomes a burden on the city at large.

"Under such a practice, knowing that repairs and renewals will be at the expense of the city, property owners benefited by the opening of new streets use all the influence in their power to have the original improvements made at the lowest possible cost, resulting in a constant heavy drain upon the general funds of the city. Certainly, if the city is to continue to reconstruct and maintain pavements solely from its general funds, it should insist, as the present administration is doing, upon an adequate pavement to start with, the major part of the cost of which to be assessed upon the property benefited.

"Generally speaking, owners of property look with disfavor upon any increase in the tax rate for general purposes, whereas there is comparatively little objection to special assessments for special benefits received. Even if the tax rate for general city purposes were not limited, as it is, by law, the general objection to any substantial increase would result in the defeat at the polls of any administration which had the hardihood to cause it. This, therefore, is a political reason why no remedy can be expected under existing laws.

"Where paving is paid for from the general funds, as in Boston, it is entirely within the power of the administration to designate just which streets shall be paved, and while all the tax payers contribute toward such general funds, only a small proportion receive any direct benefit therefrom. A pavement laid in East Boston does not directly benefit a resident of the Back Bay, altho the Back Bay resident may pay a much greater share of the cost into the general fund than do those directly benefited.

"This lack of direct benefit creates an added objection of taxpayers to contributing for paving thru the general funds of the city. Any taxpayer would prefer to pay a tax of $100 for a pavement in front of his property than to pay a tax of $1 into the general fund and take his chances of getting no direct benefit whatever. In most cases a good pavement will immediately enhance the value of a piece of property a great deal more than the cost of the pavement.

"The present condition is such that the cost of maintenance of the many miles of streets in even passable condition is frightfully high, and this maintenance cost, which is almost entirely wasted, absorbs the funds available out of current revenues to such an extent that no substantial permanent improvements can be undertaken. A competent authority has stated that $10,000,000 are necessary to put the streets of Boston in proper condition, and there can be no doubt that it would be economical for the city to provide the funds as rapidly as adequate construction work can be carried out and thereby save a large part of the present high cost of maintenance.

"It has been stated by those opposed to borrowing money

for street paving purposes that the construction and maintenance of pavements is an expense which should be paid for out of the current income of the city. This view is certainly correct as to maintenance, but it is not true as to the cost of original construction or entire reconstruction of streets. To borrow money for such length of time as the original construction, or complete reconstruction of street surfaces, can reasonably be expected to last is certainly conservative finance, but the loans made for the construction or reconstruction should be paid before it becomes necessary to again reconstruct the streets. The maintenance cost in the meantime can be provided either by requiring adequate guarantees from responsible contractors or from the general funds of the city.

"There are almost as many methods of financing street paving as there are cities. They vary from the wildest realms of high finance, such as in New York city, on the one hand to picayune inadequacy and ultra conservatism, such as in Boston, and there are all shades of methods in between. In New York City it has been customary to pay for the cost of paving and repaving on 50-year loans, and many streets of that city have already been paved or repaved as many as three times each in 50-years, and the first bonds issued therefor are still unpaid and have a number of years to run. New York City has expended upwards of $5,000,000 per annum from funds secured from long time loans. No sane person would advise the city of Boston to emulate New York in the financing of paving, but there should be no objection from any source to the borrowing of money on serial loans, the last of which will mature within the conservative life of the improvement. Many cities borrow money for 20 years for street paving purposes, but this cannot be considered to be conservative.

"A large number of cities borrow on serial loans for 10 years, confining the forms of construction to those pavements which may reasonably be expected to last that length of time with moderate maintanence cost, and this method is generally considered to be conservative finance. More conservative cities borrow for five years under similar conditions, which certainly should not cause complaint. There is no well-paved city in the United States, in my knowledge, which pays for the cost of paving, repaving and maintenance out of the general funds and within the current income from taxes, and I believe there never will be for the reasons given."

Grade Separations in Erie, Pa.

After some years of agitation and conferences with the railroad officials, Erie, Pa., has begun the actual construction on a part of the grade separation which it has been striving for. The railroads are now raising their tracks to the new height and supporting them over Parade and Divisions streets, while the city makes the excavations for lowering the streets, the specified amounts and repaves them. The City Council has appropriated $100,000 for this first step in eliminating the more important grade crossings in the city.

Several changes will be required in the city sewers before the excavations are completed and the new city engineer, F. G. Lynch, is making the necessary arrangements.

Asphalt Paving in Buffalo

The report of the Buffalo (N. Y.) Bureau of Engineering, George H. Norton, City Engineer, is devoted almost exclusively to the records of the street paving in the city. It contains the most complete records of the amount and cost of repairs, per street, per square yard, per year, in summaries, and average which have been kept by any city. It is for the year ending June 30, 1915, but includes the data for all the preceding years since Buffalo began to pave streets in 1878.

For the year of the report the cost of asphalt pavement repairs per square yard of total asphalt surface is 6.81 cents, being less than for several years on account of the thoro repairing of the streets the year before.

Of the 4½ million square yards of asphalt pavement in use, 3,895,997 square yards were laid with Trinidad asphalt, the oldest street now in use having been laid in 1879. No other asphalt was used until 1891 and 192, when rock asphalts from Germany, Sicily and Kentucky were introduced, and of each of these some 20 per cent. of the original areas have been relaid or replaced, except Sicilian, none of which has been replaced. Some block asphalt was laid in 1883, but it was replaced in 1890, 1892 and 1894, when the last disappeared. Bermudez, Alcatraz, Obispo and California asphalts were used in the years between 1898 and 1910, and of the streets on which they were used very little has been replaced, varying from about 1 per cent for Alcatraz to 0 for Obispo. A little natural rock, source not given, was laid in 1904 and taken up within a year or so.

The repairs for the year of the report covered 142,718.73 square yards, much less than the year before, at a cost of $164,987.18. The contract price for repairs was the same as the year before, except for a reduction of 20 cents a square yard on concrete base when it was required. The average cost was $1.1542 per square yard of repair actually made, and per square yard of area of streets repaired was 6.81 cents. Computed on the total yardage of asphalt maintained by the city, streets on which the construction guarantees had expired, the cost of maintenance of the area of 2,928,040 yards was 5.63 cents per square yard.

The repairs were done by two large gangs, consisting each of 4 foremen, 93 to 99 men, 10 teams, roller and rollerman. One gang worked 171 days and the other worked 48 days. A 5-ton auto truck was used 15 days, delivering asphalt, in addition to the teams. There were also 2 gangs, each with one foreman, 5 teams and 3 men repairing cuts made by the water bureau, plumbers, corporations and others. A city gang in March repaired a number of holes in two streets and two viaducts, in advance of the regular repair contract, heating and mixing up old asphalt pavement for the purpose, 235.36 square yards, costing $322, or $1.375 a square yard. The high cost was due to the low temperature and unfavorable weather conditions, but the work was necessary to preserve the streets.

The schedule of prices for the asphalt top under the regular contract was 37 cents per cubic feet of asphalt top; 17 cents of open binder; 18 cents per gallon for asphaltic cement; 51 cents a square yard for labor. This form of contract reduces the uncertainties of measurement to the one item of labor. The inaccuracies in measurement of areas actually repaired give the principal reason for differences in reported costs per square yard of repairs.

The variations in amounts of material used are easily determined.

Thus the two six months' periods of the year show that the average amount of topping used per square yard was 1.3497 cubic feet per square yard in one and 1.3651 in the other; of binder, 0.6438 and 0.7817 cubic feet, and of asphaltic cement 0.1106 and 0.1323 gal. respectively; evidence that the pavements repaired in the last half of the year were somewhat thicker than those of the first half.

The average age of all asphalt pavements out of guarantee in use or removed and replaced is 19.90 years, the difference in favor of streets without street car tracks being 2.88 years.

The average use of all such pavements over 20 years old, laid prior to 1895, of which there are 2,365, 344 square yards, is 21.25 years. The streets without tracks average 2.93 years more life than those with. The pavements laid in 1881 are 34 years old, 8,876 square yards still in use, and the pavements in each year vary in life down to 14 years for those of 1878, replaced in 1892.

The average life of the pavements replaced since 1892 was

19.27 years, with a difference in favor of streets without car tracks of 1.41 years. The streets replaced each year vary in average length of life from 14 years for the pavements of 1878 replaced in 1892 to 26.87 years for those replaced in the year of the report in streets without tracks. In streets with car tracks the variation is between 10 years' life in those replaced in 1902-3 and 22.53 in those replaced in 1913-14.

The average age of the streets now in use and not under guaranty is 20.44 years, with a difference of 4.05 years in favor of those without car tracks. It varies from 10 years for those laid in 1904-5 to 34 years for those laid in 1881, with the future life still to be measured.

Since 1903-4 the tables give the actual cost each year of repairs, the yardage of the pavement and the cost per square yard maintained for each asphalt street in the city.

Data about dimensions, cost, etc., of each street still under contractors' guarantees are also given in full.

Stone and Brick Pavements in Buffalo

The last report of the City Engineer of Buffalo, N. Y., Geo. H. Norton, City Engineer, gives full details of all street repairs in the city. It is the fullest report made by any city on this subject.

Detailed tables are given showing area, cost of repairs and cost per square yard of street maintained for each street and each year in which repairs were made. Summaries are not given for stone block and brick pavements, but the following results have been computed from the data given.

The stone block pavements are of Medina sandstone. Of stone block streets more than 20 years old the average cost of repairs per square yard per year has ranged from 0.29 cents to 11.60 cents, and for streets laid in the past 20 years 45 have required no repairs and the other 27 have had from 0.07 to 6.86 cents per square yard per year expended on them for repairs, all but 8 running below 1.5 cents.

Brick pavement tables are in the same shape as those for stone block pavements. Of the 20 streets over 20 years old two short streets have required no repairs. The repairs on the other 18 streets cost from 0.22 cents to 4.92 cents per square yard per year, all but six costing less than 0.85 cents per yard per year. Of the 50 streets from 10 to 20 years old and out of guaranty, 20 have required no repairs, and the repairs on the other 30 have ranged from 0.04 to 1.58 cents per square yard per year. Only 3 of these cost more on the average than 1 cent a yard a year for repairs.

A Demonstration of Monolithic Brick Pavement Construction on October 6

The National Paving Brick Manufacturers' Association has arranged the details necessary for a study and conference in brick pavement construction, to take place Friday, October 6, at Paris, Ill.

Headquarters of the meeting will be the Deming Hotel, Terre Haute, Ind., from which place those participating will go by interurban railway, an hour's ride, to Paris, Ill., where the construction demonstration will take place.

It will consist largely of steps showing the economy of construction details in building a brick pavement by laying the brick in green mortar, to show how such a pavement can be built with the least possible cost and yet maintain all the essentials of worth.

All persons connected in any way officially or those deeply interested in the roads of this country will be welcome at this conference, which is undertaken not only in behalf of the brick industry, but in the belief that the country itself is bound to be profited by such an opportunity.

Members of the American Society of Municipal Improvements on their way to the annual meeting of that society can spend October 6 at this conference and reach Newark the following Monday.

All those expecting to take advantage of this opportunity are requested to notify the secretary of the association, Will P. Blair, Cleveland, O., in order that they may be fully informed of the program, arrival and departure of trains, etc.

State Expenditures for Good Roads

The total outlays in 1915 by states for permanent road improvements aggregated $95,192,799. Of this amount, $30,247,593, or nearly one-third, was spent for the construction of new roads and the permanent improvement—such as macadamizing or paving—of existing ones. In addition, $12,476,122 was apportioned by the states to their counties, municipalities and other minor civil divisions for use in the construction, improvement and maintenance of roads; and a considerable portion of this sum was employed in construction and permanent improvement. The greatest outlays for roads by individual states were reported for New York, $9,393,756; California, $6,575,260, and Maryland, $3,773,223. The greatest per capita expenditure for construction and permanent improvement of roads, however, $2.82, was made by Maryland. Only twenty-three states—the six New England states, New York, New Jersey, Pennsylvania, Illinois, Michigan, Wisconsin, Minnesota, Maryland, Arkansas, Louisiana, Idaho, New Mexico, Arizona, Utah, and the three Pacific coast states—expended money directly on the construction and improvement of roads during the fiscal year, but a number of the other states apportioned sums to counties, municipalities, etc., which were spent in the construction and improvement of roads. Fourteen states, however, reported neither outlays nor apportionments for this purpose.

Demand for Highway Engineering Graduates

College and university students who specialize in the highway engineering branches of civil engineering courses will find unusual opportunities henceforth of securing early employment and good pay after winning their degrees.

There has long been a decided lack of trained road engineers and the demand for them is increasing rapidly. Probably no other branch in engineering offers such sure reward at this time.

Eighteen state highway commissions out of twenty-four reporting to the National Automobile Chamber of Commerce in New York City state that there is a lack of trained road engineers, and sixteen say that preference would be given to graduates of college highway engineering courses in the appointment of additional road engineers.

Nearly 1,600 engineers are now employed by the twenty-four state commissions, and in addition about 2,000 are employed as county and city engineers in nineteen of the states.

Salaries of highway engineers range from $900 to $5,000 a year. The average is about $1,800.

Highway commissioners report that they anticipate the number of engineers employed by the state highway departments will be doubled at least within five years.

The Philadelphia Parkway to Be Completed in 1917

The great parkway from the Philadelphia City Hall to the Green street entrance of Fairmount Park can now be completed. It has been in process of agitation, design and construction for many years, and a part of the line has been cleared and graded ready for finishing for some time.

At the last primary election a loan of $42,450,797 was voted which will furnish the money needed for the completion of the project. In July the city councils passed an ordinance appro-

priating $8,500,000 for the acquisition of the remaining properties required to supply the ground area, and $500,000 for the construction of the boulevard.

Chief Engineer William H. Connell of the Bureau of Highways states that the entire work will be completed during 1916 and 1917.

An Indiana Concrete Road

The County Commissioners of Elkhart County, Ind., are building a concrete road which is under the supervision of Albert Reith of Goshen, Ind., County Engineer, the work being done by A. M. Smith, contractor, of Goshen, Ind. The price bid for the road was $1.25 a square yard.

Construction was begun in the fall of 1915 and the road will be completed this year. It is 23,365 feet long, 18 feet wide, with 46,730 square yards, of which 2,190 square yards were completed in 1915.

The concrete is 1:2:3 mixture and laid in one course 6 inches thick at the center and 8 inches thick at the sides. The sand used was washed and well graded between 0 and ¼ inches. The gravel was hard, well graded, unwashed.

The re-enforcement used was Kahn No. 22, with 1 foot lap longitudinally and 4 inches transversely. It was placed 2 inches from the top. The expansion joints were ⅜ inch wide, filled with Carey felt and spaced 25 feet apart.

The foundation is a gravelly loam, which was well compacted and the subgrade made flat across the road.

In laying the concrete a Koehring mixer was used, wooden planks for side forms and strike board, and the surface was finished with wooden hand float from a bridge.

Reinforced Concrete Streets in Yankton, S. D.

In May and June, 1915, Yankton, S. D., laid four reinforced concrete streets, three of them 400 feet long, each, and 60, 80 and 90 feet in width, respectively, and one 2,250 feet long and 48 feet in width.

The specifications were prepared by S. H. Edmonds, city engineer, and the work was done by the M. L. Flynn Paving Company, of Sioux City, Ia.

A one-course pavement was laid, 6 inches thick, with proportions of one part portland cement, two parts of sand from the Haywarden Sand Company, and three parts of crushed quartzite from the Wisconsin Granite Company, of Sioux Falls, S. D.

Kahn No. 30 reinforcement was used, being placed 2 inches from the top. Trus-con armor plates were used for joint protection, Carey filler being used ⅜ inch thick. Transverse joints were located 25 feet apart.

The foundations of the streets were of clay, which was plowed, hand-graded to a crown and well rolled with a 10-ton roller. The gradient of two of the streets was 1 per cent., of one was 0.5 per cent. and of the longer averaged 1 per cent., with a maximum of 3 per cent.

Walnut street, 60 feet wide, 2,672 square yards, has a crown of 8 inches and 6 by 18-inch curbs. Douglas avenue, 80 feet wide, 3,555 square yards, has a crown of 11 inches. Broadway is 90 feet wide, having a parkway 30 feet wide in the center and two strips of concrete paving, each 30 feet wide, with 6 by 18-inch curb and a slope of 5 inches in the 30 feet from park curb to gutter. The area of paving is 2,756 square yards. Third street, 48 feet wide, 15,417 square yards, has a crown of 6 inches.

Inspection by the representative of the Trussed Concrete Steel Company shows good work on the whole. On three of the streets the concrete is reported to be high at the joints.

Good Roads Notes

About 85 per cent. of the roads of the country always will be roads of moderate or light traffic which should be improved at a low cost per mile and only about 15 per cent. of the mileage requires the high class of construction now so strenuously urged. If this could be understood by the opponents of highway improvement on account of cost their opposition would largely disappear.

The United States Office of Good Roads has issued a bulletin comparing three methods of paying for road construction. By the sinking fund plan there is always a temptation to use the accumulating fund for other purposes and it can not all of it be loaned all the time. On the basis of the cost of handling the bonded debt of New York it is estimated that the interest payments on a $100,000 loan for 20 years would amount to $148,000. If the annuity plan were used the annual payment would be $8,024 and the total interest paid would be $60,405. If serial bonds were issued, the principal payment each year would be $5,000, and the payment for interest would diminish each year from $5,000 the first year; the total interest payment being $50,000.

Improved roads need care. If the travel tears a little hole in the surface of a bituminous road, the hole will be rapidly enlarged unless it is patched. Sometimes this patching is put off too long, and thus everybody using the road calls it a failure, when the trouble was not due to the original road, but rather to the poor "housekeeping." State Highway Engineer Shirley, of Maryland, has found this to be the best way to do the mending: "First sweep the hole thoroly clean, free from all dirt and dust; paint the cavity with bituminous material; tamp the stone in well, then spread bituminous material over the stone and apply stone chips from ½ inch to ¾ inch in size, just bringing the surface of the patch up to the same elevation as the adjoining surface of the road. Quite a number of patrolmen can make these patches without much trouble and get the proper amount of oil in so that the patch will be permanent and not push about, but sometimes they either get too much bituminous material in and it pushes about and makes a hump, or do not put sufficient in, and the consequence is 'raveling.' To aid them, therefore, in getting just the proper amount of bituminous material in the patch, the patrolman should be supplied with a small wire basket holding about one-fourth of a peck of stone. This basket has handles, and it is only necessary for him to dip the basket with the stone in it in the bituminous material and then raise it and allow it to drain. By the time he has the hole thoroly swept out and is ready to apply the stone, the excess bituminous material has drained off, and it is only necessary to dump the stone from the basket into the hole, tamp it and cover with stone chips."

Union county, Tennessee, county court has begun the improvement of its section of the Dixie Highway. These thru routes are responsible for much road improvement, the efforts of the private parties desiring them being effective, tho sometimes slow. The best argument for the passage of the recent law appropriating $25,000,000 a year from the United States treasury for good roads is the widespread and insistent demand for these thru routes of interstate communication, altho so far the actual work must be done and paid for as a local expense.

The desire for good roads is demonstrated by the advance of $50,000 by the Bank of Leland, Greenville, Miss., on indorsement of a number of citizens, to begin work on the good roads to be built in the county under J. S. Allen, chief highway engineer, the note to be paid when cash is available from the sale of the bond issue of $960,000 for good roads, which was recently authorized.

MISCELLANEOUS

The March of Events

September 4-8, at Lexington, Ky. Southern Appalachian Good Roads Association. Joseph Hyde Pratt, secretary, Chapel Hill, N. C.

September 6-9, at Newark, N. J. League of American Municipalities.

September 13-15, at Portland, Me. New England Water Works Association. Willard Kent, secretary, Narragansett Pier, R. I.

September 14, 15, 16, at Tacoma, Wash. Washington State Association of County Commissioners. W. H. Reed, president, Tacoma, Wash.

September 18-20, at Philadelphia, Pa. Illuminating Engineering Society. C. D. Fawcett, assistant secretary, 29 West Thirty-ninth street, New York.

September 26-28, at Clifton Forge, Va. League of Virginia Municipalities. Luther C. Bronson, secretary, Portsmouth, Virginia.

October 2-6, at Grand Rapids, Mich. Playground and Recreation Association of America. H. S. Braucher, secretary, 1 Madison avenue, New York.

October 9-11, at Providence, R. I. National Housing Association, Lawrence Veiller, secretary, 105 East Twenty-second street, New York.

October 9-13, at Robert Treat Hotel, Newark, N. J. American Society of Municipal Improvements. Charles Carroll Brown, secretary, Indianapolis, Ind.

October 9-13, at Atlantic City, N. J. American Electric Railway Association. E. B. Burritt, secretary, 8 West Fortieth street, New York.

October 11-13, at Independence, Kans. League of Kansas Municipalities. C. H. Talbot, secretary, Lawrence, Kans.

October 17-20, at Chicago, Ill. American Gas Institute. G. G. Ramsdell, secretary, New York.

October 24-27, at Cincinnati, O. American Public Health Association. Prof. Selsker M. Gunn, secretary, Boston, Mass.

November 15-16, at Philadelphia, Pa. National Conference on Universities and Public Service. Edward A. Fitzpatrick, secretary, Box 380, Madison, Wis.

November 21-23, at Springfield, Mass. City Managers' Association.

November 22-24, at Springfield, Mass. Conference on Municipal Research.

November 23-24, at Springfield, Mass. Civic Secretaries' Conference.

November 23-25, at Springfield, Mass. National Municipal League. Clinton Rogers Woodruff, secretary, 705 North American building, Philadelphia, Pa.

December 27-30, at Columbus, O. American Economic Association. A. A. Young, secretary, Ithaca, N. Y.

December 27-30, at Columbus, O. American Statistical Association. Carroll W. Doten, secretary, 491 Boylston street, Boston, Mass.

February 5-12, at Mechanics' Hall, Boston, Mass. American Road Builders' Association. E. L. Powers, secretary, 150 Nassau street, New York.

Technical Schools

New York University School of Commerce, Accounts and Finance, Washington Square, New York, issues weekly bulletins of its courses of study, covering many lines of work, such, for example, as private secretary, commercial teacher, accounting, courses of day and of evening classes being outlined. A diagram in one of the bulletins shows the increase in salaries of commerce school graduates, averages of whole classes, six to eleven years out of college, running about $300 a month.

The department of ceramic engineering in the University of Illinois has now buildings and equipment costing nearly $250,000, and a staff of four specialists in this line, in addition to the work in other departments required for the four-year course under the instructors in those departments.

Wentworth Institute, Boston, is about to add to its courses of instruction one on practical concrete work, having for its object the training of young men for the work of concrete foremen and contractors. The Institute has set aside one of its best laboratory rooms for this concrete course and is fitting it up with modern testing machinery and other necessary equipment to make possible various determinations that will illustrate the technical as well as the practical sides of the applications of concrete. The first sessions will begin Monday, September 18.

Personal Notes

Benjamin E. Briggs, for twenty-three years the city engineer of Erie, Pa., who has made a high reputation as an efficient city officer as well as an expert engineer, has resigned his position and entered private practice, which he dropped to take the office so many years ago. He will make a specialty of municipal engineering. The new track elevation, the sewage disposal plant, the Mill creek improvement, an efficient and economical street repair system, the garbage disposal plant, are some of the more prominent public improvements made or planned for and begun during his administration.

A. F. Macallum, the new commissioner of public works at Ottawa, Ont., has made his appointments of the heads of departments, which include, among others, Frank C. Askwith, assistant engineer; L. McLean Hunter, pavement engineer; William F. Brice, in charge of sewers, incinerator and gar-

bage; Norman B. McRostie, in charge of sidewalks and surveys.

M. E. Brian, city engineer of Windsor, Ont., is chairman of a board of engineers to prepare plans for joint systems of water supply and sewerage for the towns along the Detroit river from Ford City to Sandwich West, opposite Detroit, Mich.

E. G. Orbert is city engineer of West Allis, Wis.

The Pittsburg Paving Joint: A Correction

The Asbestos Protected Metal Company, of Pittsburg, Pa., are the manufacturers of the Pittsburg Paving Joint, and their eastern representative is F. Wm. Stocker, Inc., Hoboken, N. J. Ray D. Lillibridge, Inc., is advertising agent for the company.

Newark Convention of American Society of Municipal Improvements

The twenty-third annual convention of the American Society of Municipal Improvements to be held at Robert Treat Hotel, Newark, N. J., October 10 to 13, promises to be one of the largest and best conventions of its long and useful career.

As usual, the committees on standard specifications will hold their meetings on Monday, October 9, and Tuesday, and will present their reports on Thursday night.

The preliminary program shows a number of papers discussing the work of bureaus of municipal research, state leagues of municipalities, state boards of health, public improvement commissions and city managers, with their relations to municipal improvements, by men directly engaged in these lines, such as E. T. Paxton, of the Texas bureau; Paul Hansen, chief engineer of the Illinois health board; W. P. Slifer, of Philadelphia, and C. A. Bingham, city manager of Norwood, Mass.

Water works problems are to be discussed by J. Walter Ackerman, of Auburn, N. Y.; breaks in cast iron pipe, by R. D. French; the scientific cleaning of settling basins, by Alexander Potter, and the Newark water plant, by the engineering department.

In the department of sewage, George A. Carpenter will make the committee report. Progress in activated sludge treatment will be reported upon by T. Chalkley Hatton, of Milwaukee; George T. Hammond, of Brooklyn; Gustav J. Requardt, of Baltimore, and Harrison P. Eddy, of Boston, who are at work upon experimental plants which are rapidly adding to our stock of knowledge concerning the process. The Atlanta Imhoff tanks will be reported upon by C. C. Hommon, the chemist in charge. George W. Fuller and H. N. Roberts will discuss the nuisance and sanitary aspects of sewage disposal. Public comfort stations and street flushing will also be discussed by experts.

In garbage and refuse disposal, E. R. Conant will present, in the committee report, data on refuse disposal. The subject will also be discussed by L. L. Tribus and Gustav R. Tuska, and E. E. Duff will report upon the system and plant in operation in Sewickley, Pa.

The traffic and transportation committee has made a detailed study of methods of making traffic counts, and J. C. Hallock, chairman, will present a proposed standard form. E W. Stern will discuss the limitation of loads, speed and size of vehicles.

The committee on street paving has made an exhaustive study of the practice regarding treatment of cuts made in pavements and will present the results of its labors. Some special problems in street construction and maintenance and in street administration will be presented by George C. Warren, W. P. Blair and H. W. Durham. Oil for treating wooden blocks will be discussed by P. C. Reilly, and the bleeding of blocks by C. H. Teesdale; experiences with concrete paving, by K. C. Gaynor, and with vertical fiber brick and wood block, by E. A. Kingsley.

These papers will be followed by the report of the committee on standard specifications, George W. Tillson, chairman, which will present the changes proposed for the adopted standard specifications, and also the wood block specifications, which have not yet been adopted.

A. P. Folwell, chairman, will present the report of the committee on standard forms.

Street lighting will have full attention, with papers by Preston S. Miller on recent developments; by C. W. Koiner, on Pasadena's municipal plant, and by Arthur J. Sweet, on the new system in progress in Milwaukee.

Alcide Chausse will report on fire prevention and John C. McCabe on uniform boiler laws. There will be the usual committee reports on several other subjects.

Newark is the center of so much of engineering interest that the local committee has broken the society's rule by devoting two sessions and a large part of a third to an automobile ride to near-by parks and reservoirs, train and boat to the new Port Newark terminal and the harbor, besides one evening for a banquet tendered by the city.

The exhibits have become a considerable feature of the society's conventions.

The attendance will be large and reservations of accommodations should be made promptly.

Further information and copies of the program as soon as printed can be obtained of Charles Carroll Brown, secretary, 702 Wulsin Building, Indianapolis. Inquiries regarding local information of any kind should be addressed to Morris R. Sherrerd, chairman of the local committee on convention arrangements, City Hall, Newark, N. J.

Sewer Overflow in St. Louis

The Mill Creek sewer in St. Louis is one of the problems in drainage of city areas which has been prominent in engineering discussions for a number of years and has given rise to studies which have been of notable assistance to engineers in designing sewers.

This sewer was recently completed and to the surprise of everyone a heavy storm on August 12 flooded the sewer and caused considerable damage from the resulting overflow. Of course a thoro investigation of the reason for the overflow was made at once and it was discovered that the sewer was blocked by three brick bulkheads which had not been completely removed.

The daily papers have published whatever could be ascertained as fact, and it appears from a study of their reports that when the sewer was accepted by the city, the Mississippi river was so high that it covered the top of the outlet to the sewer and backed up in the sewer for a considerable distance. During the construction of the sewer bulkheads had been used to keep out the river so that construction would not be interrupted. These bulkheads had been partly demolished but one was still 9 feet high and blocked about two-thirds of the sewer. When the sewer was accepted it was understood that they were to be removed as soon as the river fell enough to permit, but the intake connections above were made before the river had so fallen. On the day of the rainfall arrangements had been made to do the work, but the rain came one day too soon.

While the rain was heavy, it did not produce a run-off equal to that for which the sewer was designed. It is evident, so far as one can gather from the inexact and inaccurate and often incorrect reports in the daily papers, that the cause of the overflow was the remains of the bulkheads, which seriously reduced its capacity.

The property owners who suffered propose now to find out who is responsible and will probably attempt to collect damages.

MACHINERY AND SUPPLIES

Kelly Trucks for Our Army on the Border

The wars in Europe have proved the worth and the vital necessity of the motor truck to the modern army. The United States army has profited by European experience in this line, as is proven by the steady increase in the number of trucks used to take care of the soldiers in Mexico and on the border.

A recent example of this progressive spirit in our army is the purchase by the United States War Department of 231 trucks from the Kelly Springfield Motor Truck Co., of Springfield, Ohio—165 3½-ton and 66 1½-ton chasses. The order is for seven motor-truck companies, all fully equipped, and each comprising 33 trucks.

The Kelly Springfield Co. has undertaken an unusual thing in connection with this order. They are not only furnishing the trucks complete, bodies and chasses, but are agreeing to recruit and train the members of the companies, and turn fully prepared and organized motor-truck units, or companies of 33 trucks each, over to the Federal Government. As each company consists of a truck master and three assistants, a chief mechanic and two assistants, forty-four drivers and two cooks, it is readily seen what a job this will be.

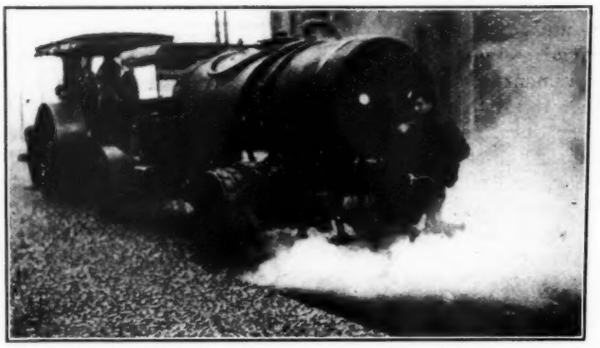
This recruiting and training has been going on for some time now. The first company left Springfield, Ohio, on July 7, on a special train for the border. Mr. F. B. Hutchinson, the sales manager of the Kelly Springfield Co., accompanied them to see that things get started right. The Government has established a permanent base for this big fleet of Kelly trucks at Nogales, Ariz. A complete service department, capable of making repairs of all kinds, has been established there.

Kinney Heater and Distributer

We are showing two views of the Kinney heater and distributer, which illustrate the side control of spray, circulating device and drop pan, spray wind shield and connection for hand-spraying hose and nozzle. The sidewise control is indicated by the hand wheel in front of operator's seat, and is so arranged as to swing the distributing pipes and nozzles two feet on either side, so as to insure perfect contact of the successive applications without overlapping or leaving bare spots on the road.

KINNEY HEATER AND DISTRIBUTER AS OPERATED BY BOSTON DEPARTMENT OF PARKS.

The circulating device is shown in part by the conducting pipe on the side of tank, receiving material from the bottom of the tank under pressure from the pump, and forcing it to the top and thence downward to the bottom of tank. This constitutes an agitator, producing a reliable and uniform temperature thruout the entire contents of the tank, also greatly hastening the process of heating.



KINNEY DISTRIBUTER AS OPERATED BY SPRINGFIELD, MASS.

The drop pan and wind shield are shown, covering the spray pipes, and serving to protect the spray from the effects of the wind. Also, by acting automatically in connection with the opening and closing of the delivery valves, the nuisance of dripping oil on cross-walks when the machine is used for dust-laying is absolutely prevented.

An open connection is also provided for the attachment of a hose and nozzle for hand spraying or patching under pressure.

The distributer equipment, which is made by the Kinney Manufacturing Company, Boston, Mass., (and mounted on Kelly-Springfield chassis), may be demounted from the truck chassis in order that the truck may be available for other purposes when not required for road oiling.

The tank being mounted upon a separate sub-frame, it is only necessary to remove the ten bolts connecting it with the steel frame of the truck, and by means of falls lift the entire oiling outfit complete from the truck chassis, take away the truck and lower the tank equipment upon proper supports, where it may remain until again needed. The time required for demounting need not exceed one-half hour and it is accomplished without detaching any parts, disconnecting any piping, or in any way disturbing the adjustment of the tank equipment.

Wilmington-Los Angeles Roadway

We are showing herewith a modern method of freight haulage from Wilmington to Los Angeles, Cal., a distance of 21 miles. The trailers, carrying 65 tons, are hauled by a Bulkley tractor.

It is not every road which will withstand this sort of heavy traffic. Our illustration shows an almost daily scene on this road and is prophetic evidence backing up our oft-repeated statement that our roads should be built to withstand the traffic they must bear a few years hence.

A large number of Armco culverts are used for the drainage of this highway and their perfect success under this tremendous traffic is one more instance of their serviceability.

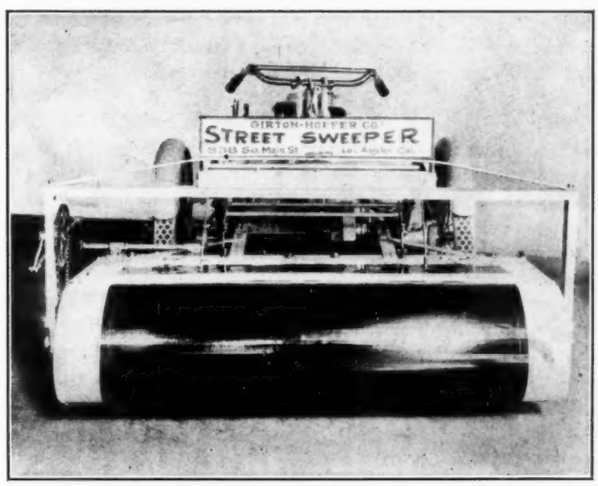
San Pedro Harbor, as it used to be called before it became the municipal harbor of Los Angeles, has been a very important commercial port of entry, practically ever since the settlement of this region by white men; and very considerable amounts of freight were hauled over the existing roadways fifty and seventy-five years ago. Phineas Banning, who in the early days owned the stage and freighting line between the seashore and Los Angeles, also owned a great deal of land in Wilmington and vicinity and was the leader of a movement which ended in the building and operating of a railroad between Wilmington and Los Angeles as early as the fall of 1869. The freight charges at that time were: Dry goods, $6.00 per ton; empty pipes, $1.00 each (whether water, steam or jimmy not stated); groceries, $5.00 per ton; passengers, $1.50 from the vessel to Wilmington and $1.00 to Los Angeles. We read without surprise that the road was profitable from the start.

Motorcycle Street Sweeper

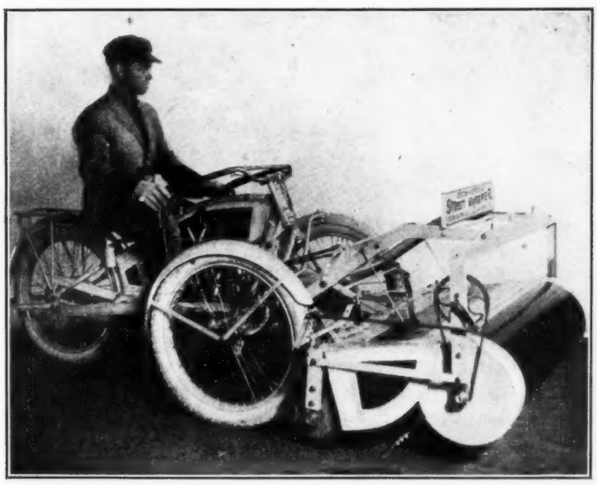
By Albert Marple, Tropico, Cal.

Something new in the way of a street sweeper has made its appearance in Los Angeles, Cal., the motive power of which is an ordinary twin-cylinder motorcycle. Economy of operation is this machine's chief asset. Actual tests prove that it will cut the street sweeping costs of a city at least 50 per cent, and in many instances considerably more. It does as effective work as a sweeper possibly can, and may be operated at a speed of from two to twenty miles an hour, but it does its most effective work at eight miles. It was invented jointly by J. F. Smedley, F. C. Hoffer and T. C. Girton, of Los Angeles.

The street sweeping appliance is built in front of a pair of wheels, attached to the forward end of the motorcycle, and steered by its handles. The brush is 5 feet in length and is raised or lowered at will by a lever located at the side of the driver's seat. It is revolved by chains over wheels turned by the motorcycle engine. Suspended immediately in front of this brush is a cylindrical sheet-iron drum, with a capacity of four bushels, into which the dirt is swept over an apron as



the brush revolves. Thru the agency of another lever, similar also to those used on automobiles, the driver is able at any moment, without dismounting, to turn the cylinder so that its contents will be dropped in a pile upon the street. Provision is made to haul a wagon body at the rear of the machine large enough to hold ten loads of the cylinder. The use of this would



do away with piles of dirt standing along the streets and at the corners.

Primarily, like all other street sweepers, this machine is built specially for work upon streets of asphalt, macadam, concrete and similar smooth materials. It will clean the rougher streets as effectively as will any street sweeper. The cost of operation is very slight. One man operates it, and the gasoline and oil consumption is very low. The inventors claim that this device will do the work of at least twenty men. If at any time trouble should be experienced in connection with the sweeping mechanism, a simple pushing of a lever at the driver's side lifts the metal tray which covers the brush and receiving side of the cylinder, so that they are immediately opened for examination.

Nye Portable Pumping Outfit

We are illustrating a type of Nye steam pump as used by the cities of Louisville, Ky., and Cadillac, Mich., in the pumping of storm water from basements and catch basins.

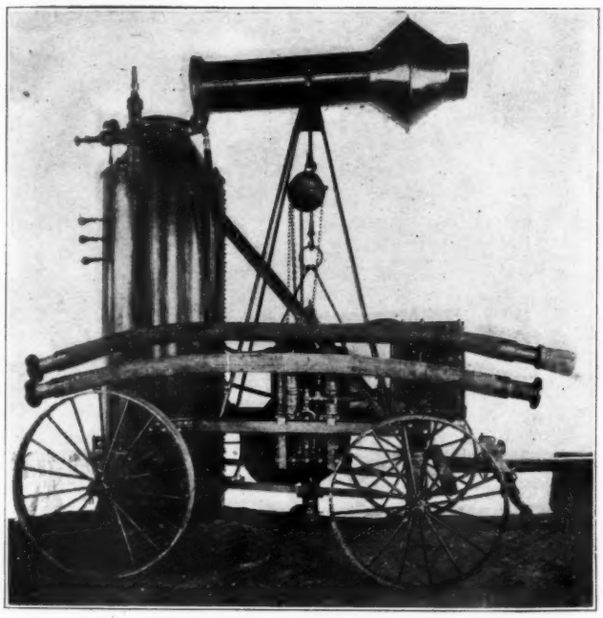
This outfit consists of boiler with all accessories, Nye pump, two 10-ft. lengths of suction hose, 50-ft. discharge hose, flexible metallic steam hose to uninterrupted steam connection within the range of the chain hoist, tank for priming, etc.

A No. 2 Nye new model pump, with 3-inch suction and 2-inch discharge, has been operated with three feet of suction and discharge one foot above pump, with only four pounds of steam indicated on a specially sensitive steam gage used for this test.

The extreme sensitiveness of the steam chest valve to the pressure, vacuum and its own gravity, which are the operating mediums, is responsible in a large degree for the high economy shown. Its function is the admission of steam to the filling cylinder in time to meet the air cushion, overcoming all shock from ram action of the rising column of water. At the beginning of the cushioning function the valve admits steam for the discharge. Filling of the alternate cylinder cuts off the supply of steam, permitting expansion of the residual charge, thereby causing discharge from both cylinders simultaneously.

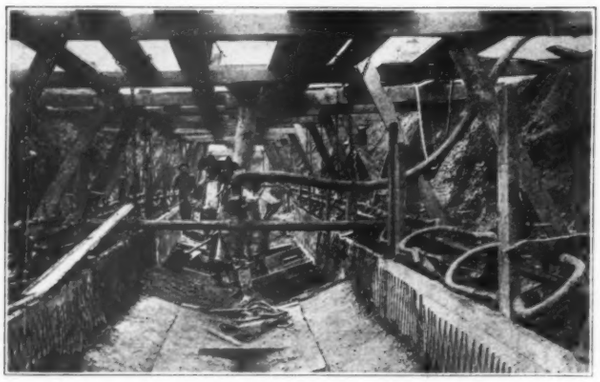
The result of this lap of discharge is a sustained momentum. An almost imperceptible increment is the only evidence of the junction of the discharge cycles. By this feature a considerable economy is effected, there being no loss of power through alternate losing and picking up of speed of the main column of discharge. This steady, positively driven discharge enables the Nye new model pumps to elevate a great percentage of solids to a considerable height.

The Nye system of jets shows, on practical tests, ability to sustain a column of mercury 29.8 inches high at sea level. This is a perfect vacuum and represents a column of water 33.9 feet high. This pump, with one steam and air-valve setting, has been in continuous service for months at a time without shut-down, giving a vacuum lift of from 20 to 25 feet.



PORTABLE NYE PUMPING OUTFIT AS OPERATED BY THE CITY OF LOUISVILLE, KY.

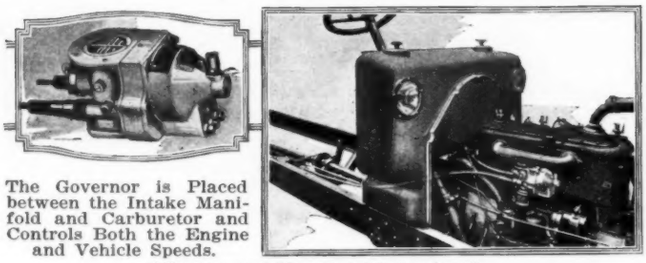
This type of pump, as manufactured by the Nye Steam Pump and Machinery Company, Chicago, may be operated to advantage at direct boiler pressure, the sensitive steam chest valve automatically taking care of variations in this pressure.



SIX NO. 2 NYE PUMPS OPERATED FROM 30-H.P. BOILER ON SEWER JOB AT LAPORTE, IND. IN PLACES THE WATER LEVEL WAS LESS THAN ONE FOOT FROM SURFACE. THIS WATER WAS SUCKED OUT OF THE SAND, AND WELL POINTS WERE KEPT IN OPERATION LONG ENOUGH TO ALLOW THE CONCRETE TO SET SUFFICIENTLY TO WITHSTAND THE GROUND WATER PRESSURE.

New Motor Truck Governor

According to "Popular Mechanics" an American-made governor, extensively employed on French military tractors, has demonstrated how the general efficiency of a motor truck may be increased, its life lengthened and the operating cost lowered. Unlike the usual instrument, this device, which is made by the Duplex Engine Governor Co., New York City, controls the maximum speed of both a car and its engine, preventing a machine from being driven at an injurious rate on high gear and safeguarding against racing the motor on intermediate ones. Separate maximum engine speeds are provided for different gears, giving increased acceleration and all of an engine's power for heavy pulls when low gear is used. The device acts automatically on a throttle valve of the grid-



The Governor is Placed between the Intake Manifold and Carburetor and Controls Both the Engine and Vehicle Speeds.

(Courtesy of "Popular Mechanics.")

GOVERNOR PROTECTS TRUCK WITHOUT CUTTING POWER.

iron type, thru which the gas passes in reaching the engine, and is attached between the carburetor and manifold. Two flexible shafts, one connected with the propulsion shaft, gear set, or jackshaft, to transmit the vehicle speed and the other extended from the camshaft, timing gears, or magneto shaft, registering the engine speed, drive the governor. These members convey their power to the governor shaft in such a way that the one revolving most rapidly drives the mechanism. When the speed of the governor is such that it exerts sufficient pressure upon a regulating rod to overcome the effect of an opposing spring the valve closes. This can be regulated by increasing or lessening the tension of the spring. The engine is under the control of the governor at all times, and when idling actuates it. The proper proportion of fuel to maintain a predetermined speed is fed to the cylinders without effort on the part of the chauffeur. If upgrade or a heavy stretch of road is encountered, the valve is opened automatically and more gas directed to the engine.

The Bates Steel Mule

The Bates steel mule, as illustrated, is so made that it can be hitched to any type of road building or maintenance machinery; the driver sitting on the machine to be hauled in the same position as when driving horses. In most cases, it is possible for the driver of the "steel mule" to also operate the machine hauled.

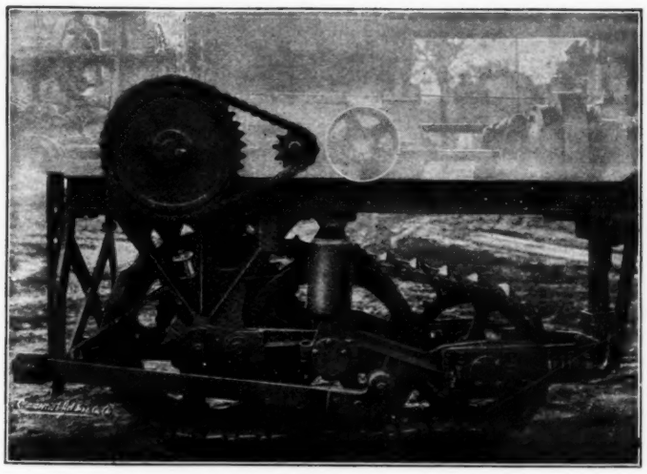
The only function the horse does is to furnish some means of pulling the machine along—that's the reason he is hitched up in front where you can watch him and guide him when you wish—while you and the implement are getting the ground or crop worked up into shape. The Bates steel mule simply goes in where the horses go—up in front, where you can watch it and guide it while you and the implement do the work.

The "crawler" consists of an endless-chain apron of metal boards, each link of which is a single piece of metal connected to the next adjoining piece by means of a connecting pin of large bearing surface. In operation the broad surface on the ground acts to the Bates steel mule as snow shoes act to a man in deep snow. It distributes the weight of the machine over so large a surface and, therefore, there are so many square inches helping to support the weight that each one does not have very much to do and, therefore, the earth does not become packed.

The control of the tractor is by means of three wheels and a lever on the end of a long column, which consists of three lengths of tubing, one inside of the other. The column being connected with the tractor thru a universal joint, can be swung at the will of the operator to any position desired. The middle wheel is the steering wheel. The wheel in front of the steering wheel operates the clutch and the smaller wheel in the rear operates the gear-shifting apparatus. The carbureter control is in the form of a lever projecting in front of the clutch wheel.

This type of tractor, as made by the Joliet Tractor Co., Joliet, Ill., does not depend on its weight to get its traction. The draw-bar is fastened to the oscillating steel side frames, making a compound lever which pulls the crawler into the ground.

DRIVING THE BATES STEEL MULE.



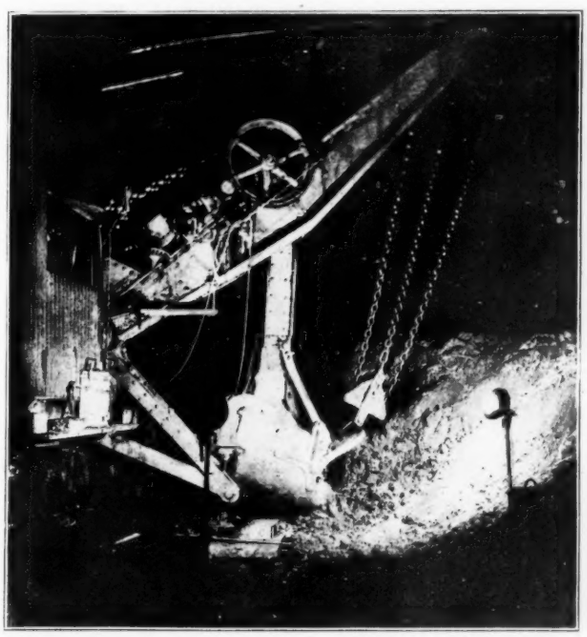
THE COMPOUND LEVER DRAW-BAR.

With a light load, where minimum traction is required, the down pull is not so great, but when a heavy pull is needed the crawler is forced into the ground as the necessity for it increases.

Under ordinary conditions of light loads, the springs give the necessary downward push to give traction to the steel mule anywhere.

Making Night Work Profitable

Good light makes all the difference between real efficiency and blundering progress on night construction work. Distinct illumination eliminates lost time and wasted motion.

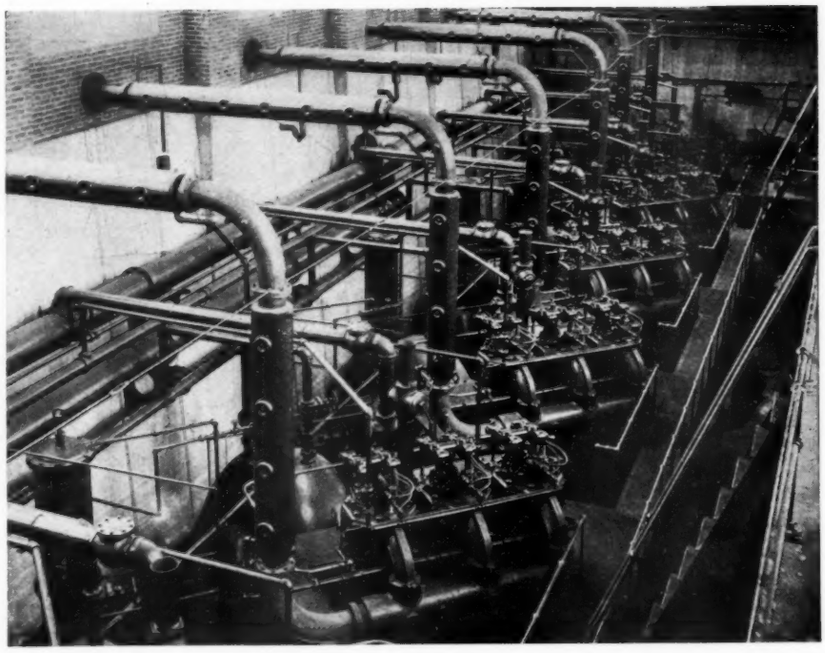


We are illustrating a type of Milburn portable light on night excavation. This type, as illustrated, burns 10 hours on a charge without attention. Still another type is designed for attachment on large mechanical equipment. The reflector is fastened to the boom, front housing or other point from which work is illuminated, while the generator is placed in the operator's cab, connection being made with a hose.

East St. Louis Pumping Station

The pumping station of the East St. Louis outlet sewer, completed in 1911, has shown no leakage thru the floor or walls of the foundation, altho the Misissippi river has at times been 15 feet higher than the lowest elevation of same.

Mr. J. A. Smith, engineer, East Side levee and sanitary district, East St. Louis, Ill., was the designing and supervising engineer for the structure, in which Medusa water-proofing powder was used in the following manner: Walls were poured in two sections, between the sections a plaster coat 1 to 2 mix of cement and sand, the cement being water-proofed with 2 pounds of Medusa water-proofing powder to each sack of cement. The floors were treated in the same manner. The foundations for this pumping station are 125x25 feet. Height from lowest elevation to top of foundation 26 feet; walls are 36 inches thick at bottom, 20 inches at top; floors, about 7 feet thick. It was necessary to have floors this heavy on account of 36-inch suction pipe for pumps imbedded in same. The sides of this foundation are reinforced by a sheet steel shell. The bottom does not contain any reinforcing material.



The foundation supports the weight of five 200-h.p. engines directly connected to 48-inch centrifugal pumps, two 190-h.p. engines directly connected to 36-inch centrifugal pumps, and all appurtenances, the total weight exceeding 200 tons.

The "A & T" Road Tractor

We are illustrating an A & T tractor pulling a large combination road machine on road maintenance work done under the supervision of Kit Carson county (Colo.) road commissioners.

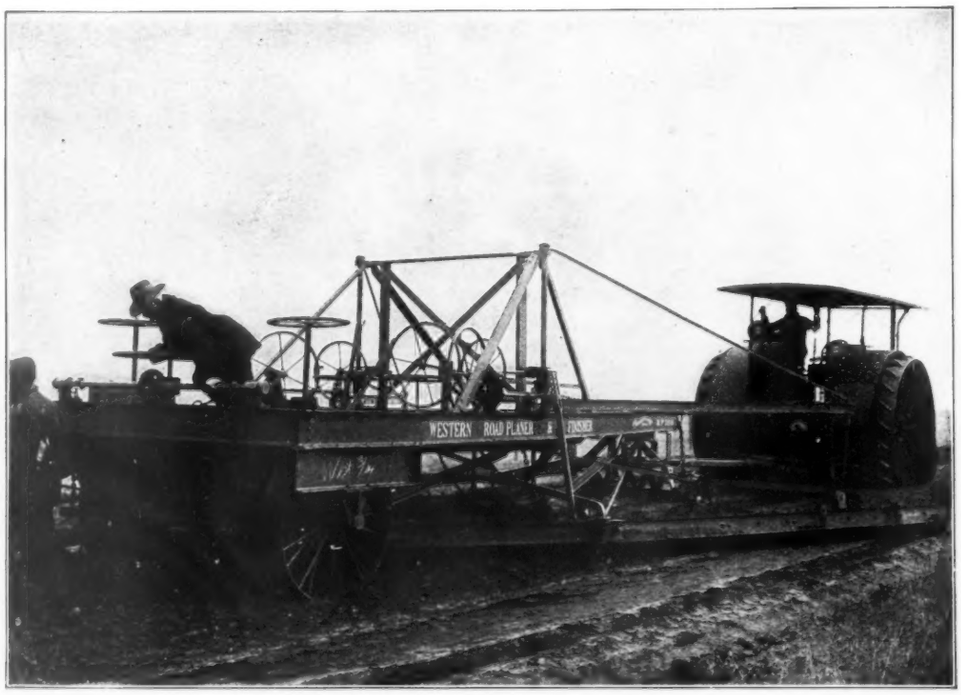
This type of tractor (gasoline-kerosene) is very extensively used for road building purposes.

The board of road commissioners, Palmer, Ill., who operate one of these types, submit their average cost for 60 days as being $8.46. The expense on a 20-mile job being:

1 tractor operator	$3.00
1 leveler operator	2.00
13 gallons gasoline	1.56
18 gallons kerosene	1.35
Oil used	.55
	$8.46

The trend in road-making machinery is toward greater capacity and the elimination of common labor, and to a con-

AULTMAN TAYLOR TRACTOR AS OPERATED BY KIT CARSON COUNTY, BURLINGTON, COLO., ON ROAD WORK.

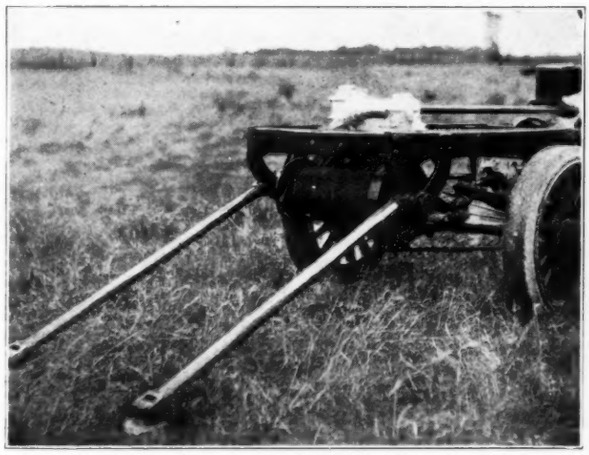


siderable extent the elimination of horse-drawn types of equipment. A study of cost records shows the reason. Formerly the item of labor constituted about 50 per cent of the cost of road construction and obviously it will for a long time be a very large factor, as it is in other kinds of engineering construction. Nevertheless, the elimination of an appreciable amount of muscular labor is often a step toward cheapening the cost of construction and therefore reducing to some extent the financial burden involved in the construction of permanent roads.

Powerful Towing Winch

We are showing a view of a towing winch designed for military chassis underneath the frame where it does not interfere with the loading space of the truck. The drum is mounted on a heavy shaft running in large bearings, and is bolted to the frame by heavy cast steel supporting arms of the I-beam type. The winch is equipped with 500 feet of cable.

The winch is driven from a power attachment on the transmission thru a propeller shaft and two universal joints to a countershaft which is geared to the winch drum. A lever mounted on the transmission cover controls the winch.



MILITARY WINCH DESIGNED BY THE RUSSIAN GOVERNMENT. USED ALSO FOR COMMERCIAL PURPOSES. VALUABLE IN ROUGH COUNTRY OR ON BAD ROADS. MAY BE USED FOR HOISTING OR PULLING TRAILERS ON ABNORMALLY STEEP GRADES, SUCH AS RIVER BANKS.

With the motor running at 1,100 revolutions per minute the cable is hauled 80 feet per minute.

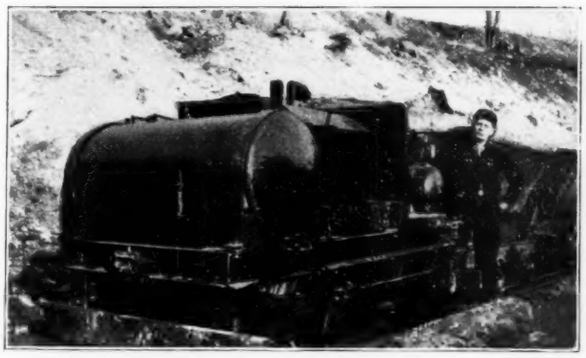
Two long braces are used to provide anchorage for heavy pulling when the weight of the car does not furnish enough resistance to hold the truck in place.

When the truck is called upon to haul a heavily loaded trailer up an abnormal grade, the truck can be run ahead of the load a distance of 500 feet. The truck can be anchored by means of the braces, and the winch can then be used to bring the load up the grade. In marshy country, in sand or other bad going, the winch may also be used to pull the truck up on to solid ground when either has become mired.

The Bell Locomotive

We are illustrating a type of locomotive as used for general haulage on tunnel and subway excavation, mucking, concreting, as well as in the construction of water, aqueduct and highway construction.

This type, which is made by the Bell Locomotive Works, Inc., New York City, ranges in sizes from 2 to 10 tons, any gage, and is equipped to burn any liquid fuel. The boiler has been approved by the United States Federal authorities after severe tests. It may be fired up in twenty minutes and contains 50 per cent greater heating surface than standard practice requires. This type is equipped with roller bearings, ground finished cylinders and pistons, drop-forged cranks, connecting rods and valve rods and oil-tight mud and dust-proof engine cases.



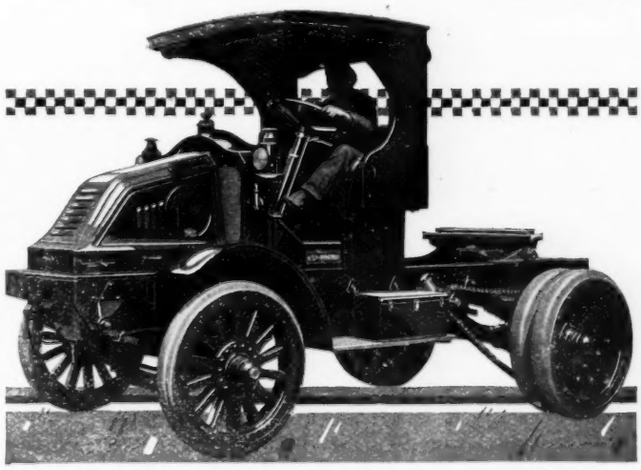
BELL LOCOMOTIVE OF 24-INCH GAGE, 6-TON WEIGHT, HAULING GRAVEL ON HIGHWAY CONSTRUCTION WORK.

Power is applied radially to the front axle; that is, the crank shaft end of the engine is geared to and at the same time rides upon this axle, seated upon heavy adjustable bronze bearings. The cylinder end of the engine is hung from the main frame by a flexible steel trap. Therefore, when the locomotive runs over uneven track and the main frame rises and falls on its springs the head end of the engine swings around the front axle a distance equal to the up-and-down motion of the springs, but the driving pinion on the crank shaft remains always positively in mesh with the driven gear on the axle. The adjustable bronze bearings which seat the crank shaft end of the engine on the axle are in effect a radius link, keeping the crank shaft always properly distanced from the axle and at the same time allowing the crank shaft (and engine) to rotate about the axle like a planetarian.

A New Kelly Tractor

We are illustrating a new type of short wheel base 3½-ton Kelly tractor, built especially for use with a semi-trailer.

By the use of this semi-trailer the 3½-ton chassis is capa-



A SPECIAL 4-TON KELLY CHASSIS BUILT TO SERVE AS A TRACTOR WITH FIFTH WHEEL. THIS CHASSIS HAS A 116-INCH WHEEL BASE.

ble of carrying six or seven tons, with the majority of that weight carried on the wheels of the semi-trailer. The tractor itself carries no more weight than it would if used as a regular truck, but it is capable of hauling a much larger weight than it can carry.

Caterpillar Type of Tractor

We are illustrating the model machine of the caterpillar type of tractor now being developed by the Martin Rocking Fifth Wheel Co., Springfield, Mass.

It is not a farm tractor, but a road tractor, and is built for hauling a wagon train. There is a device on it for engaging the axle of any wagon and raising it from the ground,

throwing the weight of the front end of the wagon on the caterpillar for traction, and at the same time giving a single vertical pivot so that the wagon may be started backward. It is rubber shod so as to make for speed. This model has already been run at a speed as high as fifteen miles an hour.

Revolving Shovel Rips up Macadam

An unusually interesting job of road grading has recently been completed on Humboldt avenue in Milwaukee by Arthur Froeming of that city. The interesting features of the work from the point of view of the contractor are very well shown up in the photograph, which we publish herewith. These features may be briefly summarized as the extreme smoothness of the floor, the ease with which the hard macadam was dug and the fact that in this shallow digging the shovel was able to load a 2-yard wagon with three dipperfuls.

The contract called for the grading of Humboldt avenue for six blocks, between Locust street and North avenue, with about 7,000 cubic yards of excavation. The old macadam roadway has been dug up and the street is being transformed into a boulevard. The total width of this boulevard is 60 feet. The center portion is to be occupied by a 20-foot grass strip left at the original grade and curbed from 20-foot roadways on either side. For three blocks the center strip is occupied by street railroad tracks. The roadways are to be paved with creosote block, laid on a concrete foundation.

Shovel Operation.

The shovel used was a 14-B Bucyrus, equipped with a 2/3-yard dipper. This machine is of the traction type and was operated on platforms. The digging as stated above was unusually heavy. The material was a hard packed macadam containing a large number of big boulders, running up in many cases to 3 feet in diameter. The cut ranged from 12 to 18 inches in depth. Each 20-foot roadway, of course, was taken by the shovel in one cut.

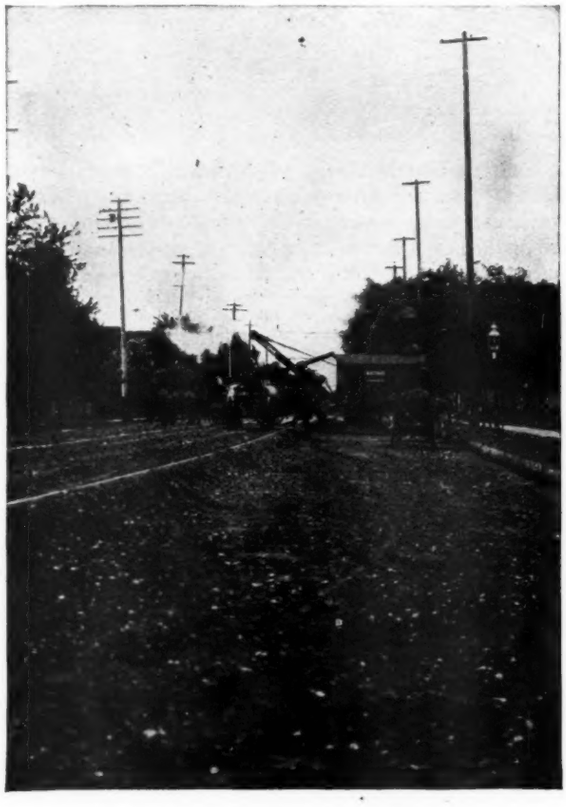
The first thing that would strike a shovelman on visiting the job, aside from its very clean-cut appearance, was the extremely level roadway left by the shovel. This was made without the help of any hand trimming whatsoever. In fact, only two pitmen were employed. One of them spent most of his time completing the trimming at the curb on the sidewalk side and the other in keeping the near rail of the trolley car track uncovered and in clearing up on the far side.

As stated, the cut ran between 12 and 18 inches deep. The ability of the shovel to take a long horizontal direct thrust enabled it to fill the dipper very easily at this depth. As a result even in this shallow digging a 2-yard dump wagon could consistently be filled with three swings. This, of course, is a great advantage, and contributes considerably toward increasing the speed of operation.

The frequent boulders which were encountered were large enough to necessitate a good deal of cutting beneath the level of the wheels. This was done with extraordinary ease by the shovel. It was impossible to give any estimate as to the output of the shovel other than it is making very satisfactory lineal progress, in spite of the fact that over a greater part of the work street car tracks occupy the center portion of the boulevard and dump wagons have to be loaded on the tracks as shown. The street cars interrupt the operation once in every 2½ or 3 minutes.

Eight 2-yard dump wagons were used. These were hauled for an average distance of about four blocks to the dump.

Another point which was noticeable was the speed with which the shovel was able to move up. It was only a matter of a very few minutes to pick up by means of chains the rear platform, which has just been passed over, to swing it around



NOTE THE SMOOTH LEVEL FLOOR.

the front, to set it in place and then to propel forward. About 2½ tons of coal were burned per week.

Arthur Froeming had the contract only for the grading. The paving is being done by Hase & Weie, of Milwaukee. Arthur Froeming, Jr., superintended the work in person. The shovel was operated by Chas. Dean and fired by H. A. Asmussen. Herman Eick was foreman.

A 64,000 Ton Blast

A very successful blast was made in the Frazier Ballast Quarries, Frazier, W. Va., on June 27th last. Blast consisted of 24 5⅝-inch well drill holes varying from 56 feet to 121 feet in depth. Also about the center of the face at the bottom there were drilled 34 16-foot snake holes, which were loaded and fired with the main shot. Snake holes were drilled to relieve a heavy toe at that point.

Well holes were spaced 16 to 17 feet apart and had an average burden of 22 feet. Red Cross Gelatin 60 per cent. and Red Cross Extra 33 per cent. dynamite were the explosives used. Nearly all holes were double loaded with usually a 12-foot break. Cordeau Bickford was used in each hole to detonate the explosives.

In all there were used in well holes 7,900 pounds of Red Cross 60 per cent. Gelatin, which was used for bottom loads, and 7,300 pounds of Red Cross Extra 33 per cent. dynamite. About 300 pounds of 33 per cent extra were used in loading the snake holes.

There were 64,000 tons of stone shot down in this blast. Stone quite well broken and distributed nicely for hand loading, the method here pursued.

The Caterpillar Tractor

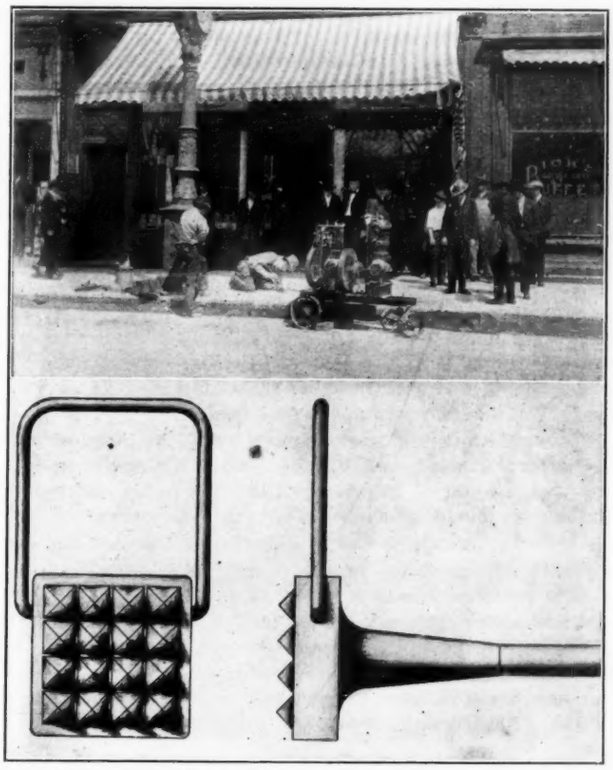
The caterpillar tractor, as illustrated, is quite extensively used for grading, leveling and haulage of materials required in the construction and maintenance of roads. Its track construction enables it to negotiate soft soils and sandy places.

The caterpillar track, as used on this model as manufactured by the Holt Manufacturing Company, Peoria, Ill., is a flexible, endless belt composed of steel links, connected by case-hardened steel space blocks and case-hardened steel track pins. Each link combines a corrugated shoe or ground contact surface and a double rail over which the truck rollers travel. The shoes have curved ends and overlap each other, so there is no opening between them at any time. These shoes are made heavy enough to withstand the severe usage. There is no friction between the shoes and the ground, the track being simply laid down and picked up again, one section at a time. The rails each have a face 2¾ inches wide, which gives a wearing surface equal to that of the ordinary railroad rail. They are 6 inches high and have openings at the side so that any dirt falling onto the track is forced out thru the openings by the teeth of the track-driving sprocket. The space blocks are machine finished, case-hardened and are fitted by pressure into broached holes in the links. With the special 30-inch width tracks, the total bearing surface is 4,800 square inches, and the ground pressure is 3 pounds per square inch. This pressure is much less than that of the foot of either man or horse.

All the weight of the tractor is carried on truck rollers, five on each side, these rollers having chilled faces so as to provide an excellent wearing surface.

New Stone Roughing Outfit

The Gardner Governor Company, of Quincy, Ill., offers to engineers and contractors the first outfit ever constructed for roughing stone. It has been tested by the Brinkoetter Monumental Company, of Quincy, and the first machine is said to have operated successfully in that city and vicinity.



NEW GARDNER STONE-ROUGHING OUTFIT. LOWER VIEW SHOWS ROUGHING TOOLS.

The outfit consists of an air-cooled air compressor driven by a gasoline engine mounted on a light steel truck. An air receiver is held under the truck. The compressor is a Gardner-Rix vertical, air-cooled, oil-splash-lubricated machine connected to the engine by a coupling. The compressor valves are of thin flexible sheet steel and cannot be drawn into the cylinder.

The tool is an ordinary plug drill fitted with a case-hardened steel block with 16 sharpened raised points. The block has a wire handle which helps to guide the tool. In chipping around cracks and posts set into the sidewalk a trimming tool is used. An unloading device regulates the air pressure for the most efficient work.

New Hand Book on Concrete Roads

The Kahn Road Book is principally devoted to useful information and illustrations on permanent concrete road construction. The large number of photographs of completed roads and those during construction add interest to the read-

ing pages. The book contains a general historical review of concrete pavements, with detailed information regarding particular sections. The reports of road commissioners are quoted on the satisfaction of the roads and on questions of maintenance. Tables are shown giving cost data as well as summary of yardage and mileage thruout the country. The reinforcing of concrete pavements is discussed and information on Kahn road mesh is included. The necessity and advantage of expansion joints occupy a section of the book, including in it practical information in regard to Kahn armor plates and installing device. Complete specifications for the one-course concrete highway, the one-course concrete street pavement and the two-course concrete street pavement are given in another section of the book, which is illustrated with views of concrete highways. Concrete curbs, with methods of protecting the edges, and the installation of these curb bars, also concrete culverts, bridge floors, etc., are treated. This information, together with tables giving quantities of materials for concrete and mortar, are included in the general Kahn Road Book.

The Kahn Road Book is issued primarily for engineers and contractors interested in pavement and road construction, including city engineers, contractors, county engineers, road commissioners, etc. To such persons the Kahn Road Book is sent on request by addressing the Trussed Concrete Steel Company, Youngstown, Ohio.

Value of Hydrated Lime in Cement Mortar

For years it has been known that the addition of a small amount of hydrated lime to cement mortar in brick work results in a more plastic, freer spreading material under the trowel. It has been the custom in many cities to specify a proportion of hydrated lime in cement mortar because it was recognized that it would make work easier.

The mortar being worked more easily under the trowel, permits mechanics to more firmly embed the bricks, and with less physical effort. The bricks will slide freely and the mortar will be forced into crevices where it is impossible to put the trowel. This all results in a bearing surface for each brick which cannot be gained by a hard working mortar.

The practical effect, however, of such mixtures of cement and hydrated lime has always been a debated question and it has remained for Prof. James S. Macgregor, of Columbia University, to arrive at actual facts, and in establishing these facts the question of debate has been removed.

Prof. Macgregor s investigation was conceived for the following reasons:

1. To indicate what value, from the standpoint of strength, the better bearing surface given to the bricks would possess when laid up with cement-lime mortars of varying proportions.

2. To determine the practical effect on strength when bricks absorb a portion of the moisture from the mortar and thus rob the mortar of the moisture needed to hydrate and harden the cement. This was to indicate whether the water carrying capacity of hydrated lime had a value in retaining moisture in the mortar which would be passed off to the cement and taken up in subsequent hydration, thus resulting in increased strength. The results shown in the summary of ultimate resistance prove this reasoning established beyond doubt.

The investigation as outlined consisted in laying up seven different sets of brick piers 8x8x84 inches high, each set consisting of 9 piers and being laid up in mortar of different proportions, with varying amounts of hydrated lime. Three piers of each set were tested under compression to the point of rupture at three different periods, namely, 7, 28, and 90 days, the results shown being the average of three piers at each period.

The bricks used in the 63 piers were hard burned face bricks purchased in the open market in New York City. There were also laid up seven piers 8x8x84 inches of common bricks, each with a different mortar mix, to be tested under compression at the 29-day period, the results of which were to serve as a check on the results shown by the face brick piers. Comparison of ultimate resistance of common brick with face brick shows how the general conclusions to be drawn agree and that the same underlying economic and structural value of hydrated lime applies to face and common brick alike.

The purpose of the investigation being to determine the effectiveness of hydrated lime, and also to determine to what extent Portland cement might be replaced by hydrated lime without reducing the factor of safety under practical conditions, mortars were mixed containing varying proportions of hydrate. The seven (7) mortars which were used in the investigation were mixed in the following proportions:

Mixtures Used—By Volume.

No. 1.	1.00 cu. ft. portland cement.
	3.00 cu. ft. sand
No. 2.	0.90 cu. ft. portland cement
	0.10 cu. ft. hydrated lime
	3.00 cu. ft. sand
No. 3.	0.85 cu. ft. portland cement
	0.15 cu. ft. hydrated lime
	3.00 cu. ft. sand
No. 4.	0.75 cu. ft. portland cement
	0.25 cu. ft. hydrated lime
	3.00 cu. ft. sand
No. 5.	0.50 cu. ft. portland cement
	0.50 cu. ft. hydrated lime
	3.00 cu. ft. sand
No. 6.	0.25 cu. ft. portland cement
	0.75 cu. ft. hydrated lime
	3.00 cu. ft. sand
No. 7.	1.00 cu. ft. hydrated lime
	3.00 cu. ft. sand

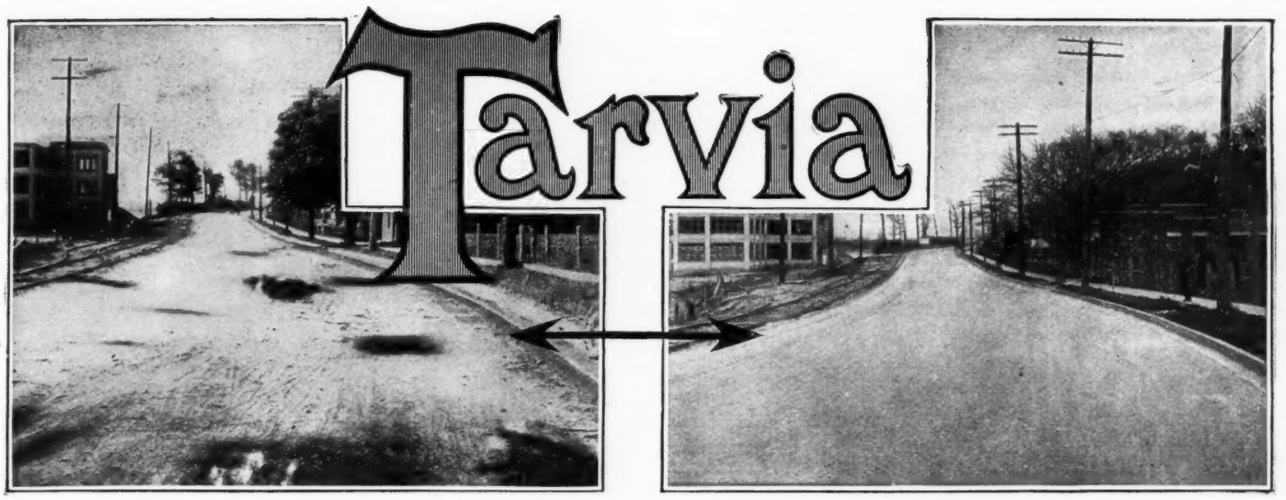
The proportions given are all by volume, and this method of measuring was followed because it is the general custom in writing building codes to so specify quantities.

Hydrated lime is nearly two and one-half (2½) times as bulky as portland cement (hydrate weighing approximately 40 lbs. per cubic foot, and portland cement weighing approximately 94 lbs.) and the true economic advantage of such volumetric replacements of portland cement by hydrated lime cannot be fully realized until the quantities shown have been reduced to corresponding weights, the basis upon which portland cement and hydrated lime are purchased.

On the basis of weight, the mortars previously shown are approximately equivalent to the following:

Mixtures Used By Weight.

No. 1.	100 lbs. portland cement
	300 lbs. sand
No. 2.	90 lbs. portland cement
	4 lbs. hydrated lime
	300 lbs. sand
No. 3.	85 lbs. portland cement
	6 lbs. hydrated lime
	300 lbs. sand
No. 4.	75 lbs. portland cement
	10 lbs. hydrated lime
	300 lbs. sand
No. 5.	50 lbs. portland cement
	20 lbs. hydrated lime
	300 lbs. sand
No. 6.	25 lbs. portland cement
	30 lbs. hydrated lime
	300 lbs. sand



Arthur Street, Manistee, Mich., before the use of "Tarvia-X" mixed macadam.

What Manistee did with Tarvia

MANISTEE, Mich., is a "Tarvia town"; that is to say, it has settled down to a regular policy of using Tarvia for the maintenance of its macadam roads.

It has learned, as other towns have learned, that the cheapest way to maintain macadam under modern conditions is to bond the stone with Tarvia.

As a result of this policy extending over nine years, Manistee has many miles of beautiful smooth pavements.

Notice from this record of sales how the tarviated areas have been extended year by year.

In 1907	2,500 gallons
1908	4,800 gallons
1909	3,000 gallons
1910	14,000 gallons
1911	21,000 gallons
1912	18,000 gallons
1913	9,000 gallons
1914	34,000 gallons
1915	32,000 gallons

Manistee makes use of all three kinds of Tarvia. It has used "Tarvia-B" for surface work and dust suppression, "Tarvia-A" for resurfacing operations and "Tarvia-X" for road building.

Hundreds of other towns throughout the country have found Tarvia the most satisfactory and economical answer to their road problems.

Illustrated booklet describing the treatments on request.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Nashville Salt Lake City Seattle Peoria
THE PATERSON MANUFACTURING COMPANY, Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

No. 7. 40 lbs. hydrated lime
300 lbs. sand

It will be noticed that the mortar designated as No. 5 contained a total of 70 lbs. of cementing agent with 300 pounds of sand, or 1 to 4.3 by weight, which may be compared with mortar No. 1 which was composed of 100 lbs. of cementing agent to 300 lbs. of sand, or 1 to 3 by weight.

The economic advantage, the saving in dollars and cents, between mortar No. 1 and mortar No. 5 is therefore measured by the decreased quantity of cementing agent contained in a given volume of mortar, or approximately 30 per cent saving, provided lime and portland cement are sold at the same price per unit of measure.

SUMMARY OF ULTIMATE RESISTANCES.
(Face Brick)

Figures shown are in pounds per square inch.
Each result is an average of crushing three piers.

Mortar Mix. No.. ..	1	2	3	4	5	6	7
Crushed at:							
7 Days 2630	3080	2890	3120	2760	1945	1535	
28 Days 2840	3170	3230	3470	3100	2370	1870	
3 Months 2840	4435	4300	4170	3820	2720	1950	

It will be noticed that the results, when mortar No. 5 was used, show a compressive value of 980 lbs. per square inch greater than Mortar No. 1 in 3 months. It has already been noted that mortar No. 5 contains 30 per cent less of cementing ingredients (or 43 per cent more sand carrying capacity.) Herein lies the extraordinary economic advantage, the greater strength at less expense.

Assuming the market price of portland cement and hydrated lime to be the same, pound for pound, it will readily be seen that specifications calling for a mortar to be composed of 50 lbs. of hydrated lime and 300 lbs. of sand (approximately ½ cu. ft. portland cement, ½ cu. ft. hydrated lime and 3 cubic feet of sand) will not only give a much higher structural value, but will also make a saving of 30 cents on every dollar spent for the cementing mixture in brick mortars.

To insure accurate measurements in practical work, it may be stated that an eight quart pail holds approximately 10 lbs. of hydrated lime, and for each bag of portland cement used in making mortar four (4) pailfuls of hydrated lime should be placed in the mixture to secure results equivalent to those produced in the No. 5 test.

Trade Notes

The National Transportation and Electric Service Corporation, Davenport, Iowa, are demonstrating at their office their system of automatic electric transportation on elevated tracks, requiring no operators of cars, which they propose for the use of rural districts in shipping goods and products to and from the farm at a cost less than that of the interurban railway and more flexible and adaptable to the local conditions. The inventor is also the inventor of the electric factory truck now in such common use, and most commonly seen perhaps as used by the express companies about the larger railroad stations.

Justus Roe & Sons, Patchogue, N. Y., who have for many years manufactured steel tapes for the use of engineers, are distributing a postal card, announcing reduced rates on several sizes of a new tape which they have recently patented, for the purpose of advertising and introducing it. Ask for the postal card cut-rate price list.

E. R. Marker, Wisconsin district manager for the T. L. Smith Company, manufacturers of mixers and traction pavers, has moved to new quarters at 609 Wells street, Milwaukee, Wis.

That bitulithic is popular in Rome, N. Y., is shown by the fact that 91,312 square yards have been laid on the streets of the city. The first contract, for 17,878 square yards, laid in 1902, was given six years to demonstrate itself, but since that time, beginning with 1908, increasing amounts have been laid, property owners apparently being ready to pay for pavements about every other year.

The Shawmut Paving Brick Works, of Shawmut, Pa., and the Pennsylvania Clay Company, of Pittsburgh, Pa., have become licensees of the Dunn Wire-Cut Lug Brick Company. The Shawmut company has an approximate daily capacity of 30,000 paving brick, but the company is contemplating the enlargement of the plant to a 50,000 daily capacity. The Pennsylvania Clay Company has one plant at Conway, Pa., with a capacity of 60,000; one plant at Crow's Run, Pa., with a capacity of 60,000, and one plant at Brady's Run, Pa., with a capacity of 40,000. The acquisition of these two companies gives the Dunn Wire-Cut Lug Brick Company thirty-two licensees, operating fifty-two plants.

Trade Publications

The Meridiograph for determining the true meridian in a minute or two is one of the serviceable inventions of low cost made by Louis Ross, civil engineer, 268 Market street, San Francisco, Cal.

E. I. duPont de Nemours & Co. have sent a booklet describing their various products, of which there are more than 200, classified as high explosives, low explosives, black blasting powder, sporting powders, explosives for military uses, chemicals, blasting supplies, fabrikoid, pyralin, nitre cake and a dozen or two miscellaneous and by-products. The products suitable for each of some 200 classes of customers are separately listed for their benefit. The booklet is bound in fabrikoid, which is an excellent substitute for leather for this and many other purposes.

The A. & F. Brown Co., 79 Barclay street, New York City, issue an excellent catalog of the transmission machinery they manufacture.

Fletcher cores for casting pipe are strikingly called to notice by a circular sent out from 820 Gwynne building, Cincinnati, O.

The sample book of drawing, tracing and blue-print papers of the American Blue Print Paper Co., 406 Dearborn street, Chicago, Ill., shows a full line and is a convenience for the engineer's office.

"Permanent Concrete Roads" is the subject of a booklet issued by the Trussed Concrete Steel Co., Youngstown, O., which is full of information about materials and methods of construction, specifications, cost data, areas and mileage in use, cross sections, drainage structures and other material of value in connection with the good roads propaganda.

Chain Belt traveling water screens for removing foreign matter from water used about the power plant are shown in Bulletin 64 of the Chain Belt Co., Milwaukee, Wis.

The Trus-Con Laboratories, Detroit, Mich., issue an advertising card concerning Bar-Ox, inhibitive preservative coating, which makes good use of the current thought on preparedness, plus preservation.

A booklet of Wallace & Tiernan Co., New York, entitled "Protecting the Water Supply of Greater New York," illustrates the application of liquid chlorine to various supplies of that city for sterilizing the water.

The economy of Blawforms for sidewalk, curb, curb and gutter, and road construction is shown, with full details of the forms and their use, in Bulletin 69 of the Blaw Steel Construction Co., Pittsburgh, Pa.

The Koehring Machine Co., Milwaukee, Wis., devote one of their circulars on concrete mixers to a discussion of mixer depreciation and how to reduce it to a minimum.